NAVAL POSTGRADUATE SCHOOL
Monterey, California

THESIS

THE EFFECT OF GRADUATE EDUCATION ON THE JOB PERFORMANCE OF CIVILIAN DEPARTMENT OF DEFENSE EMPLOYEES

by

Abdullah Usan
and
Mustafa Utoglu

September 1999

Thesis Advisors: Stephen L. Mehay
Julie Filizetti

Approved for public release; distribution is unlimited.

REPORT DOCUMENTATION PAGE

Form Approved OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instruction, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188) Washington DC 20503.

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	September 1999	Master's Thesis

4. TITLE AND SUBTITLE
THE EFFECT OF GRADUATE EDUCATION ON THE JOB PERFORMANCE OF CIVILIAN DEPARTMENT OF DEFENSE EMPLOYEES

5. FUNDING NUMBERS

6. AUTHOR
Usan, Abdullah and Utoglu, Mustafa

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Naval Postgraduate School
Monterey, CA 93943-5000

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)

10. SPONSORING / MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES
The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.

12a. DISTRIBUTION / AVAILABILITY STATEMENT
Approved for public release; distribution is unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT (maximum 200 words)

The purpose of this thesis is to investigate the effects of graduate education on the job performance of Department of Defense (DoD) civilian employees. The data used in this thesis were drawn from the Department of Defense Civilian Personnel Data File, which was provided by the Defense Manpower Data Center. The raw data were restricted to employees who possess at least a Bachelor's degree and are paid under General Schedule (GS) or General Management (GM) pay systems. Four performance measures were developed to investigate the effect of graduate education on job performance: salary level, promotion, retention, and performance rating. Four multivariate models were constructed for these performance measures. Ordinary least square (OLS) techniques were used to estimate the salary model. Logistic regression was used to estimate the promotion, retention, and performance rating models. The results found that the effect of having a Master's degree was positive in the salary, promotion, and performance ratings models. The effect of a Master's was negative in the retention model. All these findings were consistent with basic human capital investment theory. The thesis recommends that future research develop alternative job performance indicators and focus on specific occupations and functional areas.

14. SUBJECT TERMS
Graduate education, job performance, DoD civilians, salary, promotion, retention, performance rating

15. NUMBER OF PAGES 134

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	UL

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. 239-18

Approved for public release; distribution is unlimited

THE EFFECT OF GRADUATE EDUCATION ON THE JOB PERFORMANCE OF CIVILIAN DEPARTMENT OF DEFENSE EMPLOYEES

Abdullah Usan
First Lieutenant, Turkish Army
B.S., Turkish Army Academy, 1994

Mustafa Utoglu
Lieutenant Junior Grade, Turkish Navy
B.S., Turkish Naval Academy, 1994

Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN MANAGEMENT

from the

NAVAL POSTGRADUATE SCHOOL
September, 1999

Authors: Abdullah Usan

Mustafa Utoglu

Approved by: Stephen L. Mehay, Principal Advisor

Julie Filizetti, Associate Advisor

for Reuben T. Harris, Chairman
Department of Systems Management

ABSTRACT

The purpose of this thesis is to investigate the effects of graduate education on the job performance of Department of Defense (DoD) civilian employees. The data used in this thesis were drawn from the Department of Defense Civilian Personnel Data File, which was provided by the Defense Manpower Data Center. The raw data were restricted to employees who possess at least a Bachelor's degree and are paid under General Schedule (GS) or General Management (GM) pay systems. Four performance measures were developed to investigate the effect of graduate education on job performance: salary level, promotion, retention, and performance rating. Four multivariate models were constructed for these performance measures. Ordinary least square (OLS) techniques were used to estimate the salary model. Logistic regression was used to estimate the promotion, retention, and performance rating models. The results found that the effect of having a Master's degree was positive in the salary, promotion, and performance ratings models. The effect of a Master's was negative in the retention model. All these findings were consistent with basic human capital investment theory. The thesis recommends that future research develop alternative job performance indicators and focus on specific occupations and functional areas.

TABLE OF CONTENTS

ACKNOWLEDGEMENT

We want to thank our principal advisor Dr. Stephen Mehay and second reader Julie Filizetti for their great contribution to the quality of this work through their superb analytic, professional, and editing abilities. Their guidance and assistance during the writing of this thesis is greatly appreciated. We also want to thank Dennis Mar for his assistance during the coding stage of the data analysis.

I. INTRODUCTION

A. BACKGROUND

This study examines the effects of graduate education on the job performance of Department of Defense (DoD) civilian employees. Human capital investment theory suggests that an individual's productivity, and therefore his/her earnings, increases with additional education. As with other types of investments, an investment in human capital entails costs that are borne in the near term with the expectation that benefits will accrue in the future. In the case of educational and training investments by individuals, the expected returns are in the form of higher future earnings and increased job satisfaction over one's lifetime.

The basic human capital investment model assumes that people are utility maximizers and take a lifetime perspective when making choices about education and training. For this reason, individuals are assumed to compare the near-term investment costs with the present value of expected future benefits when making a decision about additional schooling. Investment in additional schooling is attractive if the present value of future benefits exceeds costs. Utility maximization requires that people continue to make additional investments in human capital as long as benefits exceed costs and to stop only when the (marginal) benefits of additional investments are equal to or less than the additional (marginal) costs. In the case of graduate education, an individual invests in such a program expecting higher future earnings, promotion to higher levels in the organization in which he/she works, or other pecuniary and non-pecuniary benefits.

According to human capital theory, we can classify education/training into two categories: general and firm specific. General education/training increases an individual's productivity to any number of potential employers at the same time. On the other hand, firm-specific education increases an individual's productivity in the current employer/ organization but not in other firms. One difference between the two types of training is in who pays for the training. Because general training is easily transferred to other firms, the employee's firm has no incentive to pay for this type of training. If the firm provides general training then the individual pays for the training through lower wages so the firm can recoup the cost of the training. Specific training is paid for by the firm, or by both the individual and the firm.

So far, the effects of post-secondary education on earnings have been studied extensively. But few researchers have investigated the effect on individual workers within a firm or organization. For example, David A.Wise conducted two studies in 1975 and concluded that graduate education provided a positive increase on salary for the employees of a single firm. Studies that have observed this effect have attributed the higher earnings to better job performance. On the other hand, James Medoff and Katharine Abraham (1980) found a positive association between experience and relative earnings within grade levels in three U.S. manufacturing corporations. They found that having a Master's degree had a positive effect on earnings but when grade level was controlled this effect decreased significantly. However, they found either no association, or a negative association, between experience and rated performance (a proxy for productivity). They suggest that these findings provide evidence contrary to implications

of human capital theories that the higher earnings of more experienced workers in a firm reflect their on-the-job training, which makes them more productive than their less experienced peers. B. Dunson (1985) replicated one of the Medoff-Abraham tests to examine whether differences in earnings for a selected group of civilian middle managers and professionals in the DoD can be explained by the hypothesis that more experienced workers are more productive workers. His results were similar to those of Medoff and Abraham. He also found that graduate education had a positive effect on earnings, but this effect decreased significantly, as in Medoff - Abraham study, when grade level was controlled. The data set used by B. Dunson is the same one used in this study.

Mehay and Bowman (1999) examined the effect of graduate education on the job performance of Navy officers. They used promotion as a performance measure and found that those with graduate degrees were more likely to be promoted. The effect was somewhat larger for those with degrees funded by the Navy. However, the effects of graduate degrees were smaller in models that adjusted for selection bias. These results contradict, to some extent, those in Medoff – Abraham and Dunson. Thus, there is some controversy as to whether graduate education actually improves a worker's on-the-job performance or whether such degrees merely signal desirable attributes to potential employers.

In this research, we investigate the effect of graduate education on the job performance of DoD civilian employees and attempt to determine whether the link between advanced degrees and job performance is causal in nature. The research relies on measures of promotion and performance within a single large organization.

B. PURPOSE OF THE THESIS

The purpose of this research is to explore the impact of various background, experience, and demographic factors, with specific emphasis on graduate education, on the job performance of DoD civilian employees. The research requires reviewing the nature of the federal civilian personnel system including pay, promotion and performance appraisal. This review will assist us in developing measures of productivity and constructing multivariate models to explore the determinants of on-the-job performance.

The data used in this thesis were drawn from Department of Defense Civilian Personnel Data Files, which were provided by Defense Manpower Data Center (DMDC). Two data files exist for DoD civilian personnel: (1) an inventory (current status) file, and (2) a transaction (dynamic) file. Both files contain similar data elements. For the purpose of this study, the DMDC merged these two files. These files cover personnel paid from appropriated funds in all Defense agencies except the National Security Agency, the National Imagery and Mapping Agency, and the Defense Intelligence Agency. They also exclude coverage of foreign national direct and indirect hire civilian employees outside the 50 states and the District of Colombia. However, the raw data used in this thesis were restricted to employees who possess at least a Bachelor's degree and are paid under General Schedule (GS) or General Management (GM) pay systems.

The primary research question for this thesis is: "What is the effect of graduate education on the job performance of DoD civilian employees?" A secondary question is: "What is the payoff to employees and the DoD of advanced education?" To be able to

answer these questions different performance measures such as salary level, promotion, performance ratings, differential between consecutive salaries, time elapsed between consecutive promotions, and retention should be investigated. In this thesis, we analyze four of these performance measures: salary level, promotion, performance ratings, and retention.

C. ORGANIZATION OF THE THESIS

This thesis is organized into six chapters. Chapter II gives summary information about the DoD civilian workforce. After providing general information and discussing summary statistics, the chapter reviews the performance management, promotion, and pay systems that apply to DoD civilians. It provides important information necessary for understanding DoD's pay, promotion and performance appraisal systems and for specifying the statistical models of this thesis. Chapter III provides a brief review of human capital theory. It also reviews six past research efforts on the payoff to graduate education. Chapter IV describes the data set used in this study and explains the methodology for constructing multivariate performance models used to measure the effects of graduate education on job performance. It also provides descriptive statistics about each sample used in the models. Chapter V presents the results of the multivariate analyses for four different performance models specified in Chapter IV. Chapter VI summarizes the results, provides conclusions about the returns of graduate education and makes recommendations for further areas of research.

THIS PAGE INTENTIONALLY LEFT BLANK

II. BACKGROUND

This chapter provides general background information and statistics about the DoD civilian workforce. It also reviews the performance management, promotion, and pay systems that apply to DoD civilians. This information is necessary for understanding DoD's pay and promotion systems and the statistical models specified in Chapter IV.

A. GENERAL

The Department of Defense (DoD) civilian workforce is a crucial link in the United States' national defense. The DoD employs more than 800,000 civilians around the world and, even with the drawdown, it remains by far the federal agency with the largest number of employees. Civilians comprise about one-fourth of the all DoD personnel. They develop and maintain sophisticated systems, manage complex programs, handle the day-to-day business of feeding, housing and paying personnel, and sometimes go in harm's way to support uniformed military forces. [Ref. 2] For purposes of this thesis, we will define the DoD civilian workforce as those in the continental U.S. excluding the National Security Agency, the National Imagery and Mapping Agency, and the Defense Intelligence Agency. Table 2.1 provides total civilian personnel strength by agency for FY1986 through FY1998. The table indicates that the DoD civilian workforce has fallen over 30 percent since 1986 as a result of the defense downsizing.

Table 2.1. DoD Direct Hire Civilian Personnel Strength Level by Agency (Fiscal Years 1986-1998)

FY	Army	Navy	Air Force	Other DoD	Total
1986	389,960	335,651	252,127	90,236	1,067,974
1987	393,803	347,915	254,446	93,854	1,090,018
1988	372,619	341,655	243,110	92,235	1,049,619
1989	382,014	347,456	250,840	95,127	1,075,437
1990	361,694	334,271	239,820	98,367	1,034,152
1991	352,254	321,806	225,001	113,655	1,012,716
1992	327,515	304,369	207,633	143,257	982,774
1993	296,436	278,746	195,034	150,963	921,179
1994	283,303	258,657	189,588	148,330	879,878
1995	273,231	238,067	180,148	140,360	831,806
1996	262,423	221,684	177,024	134,730	795,861
1997	249,917	204,930	172,343	122,271	749,461
1998	239,187	196,697	166,096	115,921	717,901

Source : From Ref. [1]

DoD's civilians are highly talented and well educated. Table 2.2 shows that, as of February 1999, nearly 70,000 (or 10 percent) hold advanced degrees, and over 210,000 (over 30 percent) have at least a Bachelor's degree. Civilian workers are engaged in a variety of jobs: scientists, engineers, logisticians, accountants and budget analysts, purchasing agents, computer specialists, linguists, human resource managers, lawyers, physicians and nurses, veterinarians, and equal opportunity specialists. While 25 percent of DoD civilian workers hold blue-collar jobs, 75 percent hold professional, technical, administrative, and clerical positions. The percentage of white-collar workers in DoD is considerably higher than the percentage in the overall civilian workforce in the U.S., which was 58.6 percent in 1997 [Ref. 3: pp. 417-419].

Table 2.2. Distribution of DoD Civilian Employees by Educational Attainment and Agency (February 1999)

Education	Army		Navy		Air Force		Other DoD		Total	
	Number	%	Number	%	Number	%	Number	%	Number	%
No HS Dip.	3,307	1.5	4,102	2.2	1,703	1.1	1,783	1.7	10,895	1.6
HS +	150,826	67.4	124,764	65.8	114,310	71.8	73,947	66.2	463,847	67.5
BA/BS	47,150	21.1	43,376	22.9	27,716	17.4	25,731	21.9	143,923	21.0
MA/MS+	22,458	10.0	17,304	9.1	15,409	9.7	12,764	10.2	67,935	9.9
Total	223,741	100	189,496	100	159,138	100	114,225	100	686,600	100

Source: After Ref. [4]

The DoD hires nearly 20,000 new civilian employees every year in a variety of occupations all over the world. Tables 2.3 and 2.4 show that DoD is the nation's largest employer of women and minorities. DoD's civilian workforce consists of 258,289 women (37 percent of all employees), 97,349 African Americans (14 percent), and 42,765 Hispanics (6 percent). The DoD has been a model of diversity for other agencies and institutions, providing opportunities without regard to race or gender. The DoD also invests in a variety of computer technologies to accommodate individuals with disabilities. Despite a significant downsizing, the DoD has been able to retain its diverse workforce. Personnel cuts in the 1990's have affected men and women in equal proportions. In 1999 female employees comprise 37.6 percent of the workforce, the same proportion they did in September 1989 before the beginning of the defense downsizing. At the same time, the DoD has made progress in increasing representation of women and minorities in its higher graded positions. In grades GS-13 (general schedule) through SES (senior executive service), the proportion of women has increased from 14 to 19 percent. The proportion of minority group members has also increased from 10 to 12 percent in

the same grades. In response to major changes in the nation's defense needs, the DoD is reshaping the total force. But it is ever mindful of the continuing need to recruit, train and retain high quality people. [Ref. 2]

Table 2.3. Distribution of DoD Civilian Employees by Gender and Agency (February 1999)

	Army		Navy		Air Force		Other DoD		Total	
Gender	Number	%	Number	%	Number	%	Number	%	Number	%
Male	139,789	62.5	128,521	67.8	107,006	67.2	52,995	46.5	428,311	62.4
Female	83,952	37.5	60,975	32.2	52,132	32.8	61,230	53.6	258,289	37.6
Total	223,741	100	189,496	100	159,138	100	114,225	100	686,600	100

Source: After Ref. [4]

Table 2.4. Distribution of DoD Civilian Employees by Race and Agency (February 1999)

	Army		Navy		Air Force		Other DoD		Total	
Race	Number	%	Number	%	Number	%	Number	%	Number	%
White	164,803	73.7	135,695	71.6	120,846	75.9	79,979	70.0	501,323	73
Black	34,100	15.2	25,166	13.3	16,496	10.4	21,587	18.9	97,349	14.2
Hispanic	13,460	6.0	8,300	4.4	15,022	9.4	5,983	5.3	42,765	6.2
Other	11,378	5.1	20,335	10.7	6,774	4.3	6,676	5.8	45,163	6.6
Total	223,741	100	189,496	100	159,138	100	114,225	100	686,600	100

Source: After Ref. [4]

B. PERFORMANCE MANAGEMENT

According to the DoD Directive 1400.25 on "Civilian Personnel Management System," [Ref.5] the objective of performance management is to improve individual, team (where applicable), and organizational performance. An integral part of this objective is the establishment of management accountability for Equal Employment

Opportunity (EEO) and Affirmative Employment Program (AEP) practices and principles. According to the Directive, in achieving this objective, performance management programs should:

- be designed to meet and integrate fully into organizational or mission goals and objectives, and management processes;

- be designed and used as tools for executing management and supervisory responsibilities; communicating and clarifying organizational goals and objectives to employees;

- identify employee, team, and managerial accountability for the accomplishment of individual, team and organizational goals and objectives;

- provide for planning, monitoring, developing, and evaluating individual, team, and organizational performance; use appropriate measures of performance to recognize and reward employees; and use the results of performance appraisal as a basis for appropriate personnel actions;

- support and be consistent with merit system principles in the United States Code. [Ref. 5]

1. Performance Appraisal System

The DoD Performance Appraisal System governs all performance appraisal programs for covered employees within the DoD [Ref. 5]. It establishes performance appraisal program requirements and it complies with Federal regulations (United States Code, Code for Federal Regulations) and other applicable laws and regulations.

Federal employees are subject to periodic appraisals of their job performance under Performance Management Regulations issued by the Office of Personnel

Management (OPM). These performance appraisal procedures can have an impact on a wide variety of personnel and employment decisions affecting federal workers. Under the performance management rules, agencies must establish performance appraisal systems that:

- provide for periodic appraisals of job performance;
- encourage employee participation in establishing performance standards; and
- use appraisal results as a basis for personnel actions affecting employees. [Ref.6]

The performance appraisal systems set up and used by agencies also must be designed to accomplish the following:

- establish performance standards that will permit accurate evaluations of job performance on the basis of objective criteria related to the job;
- communicate to each employee the performance standards and critical elements of the employee's position with respect to initial appraisal periods, and thereafter at the beginning of each following appraisal period;
- evaluate each employee on such standards during the appraisal period;
- recognize and reward employees whose performance so warrants;
- assist employees in improving unacceptable performance; and
- reassign, demote, or remove employees who continue to have less than acceptable performance, but only after such workers are given an opportunity to demonstrate acceptable performance. [Ref. 6]

The appraisal systems must be based on objective, job-related criteria and performance standards must be developed for each element of the job on which an employee is to be evaluated. Performance standards are the expressed measure of the level of achievement established by management for duties and responsibilities of a position or group of positions. Performance standards may include, but are not limited to, elements such as quantity, quality, timeliness, and manner of performance. Agencies are encouraged to have employees participate in establishing their standards. Each department and agency sets up its own performance appraisal system based on OPM's general regulations. [Ref. 6: p. 231]

2. Summary Level

Each performance appraisal program must provide a method for deriving and assigning a summary performance level from one, and only one, of the following patterns. These patterns, shown in Table 2.5, are based on appraisal of performance on critical elements and, where applicable, non-critical elements. In Table 2.5, Level 1 through Level 5 are ordered categories, with Level 1 as the lowest and Level 5 as the highest: Level 1 is "Unacceptable"; Level 3 is "Fully Successful" or the equivalent; and Level 5 is "Outstanding" or the equivalent as of 1996.[1] These patterns give flexibility to the agencies to set their own appraisal systems.

[1] Before FY1996 the ordering of the rating levels was reverse (e.g., 1-outstanding, and 5- unacceptable).

Table 2.5. Patterns of Summary Performance Levels

PATTERN	SUMMARY LEVEL				
	1	2	3	4	5
A	X		X		
B	X		X		X
C	X		X	X	
D	X	X	X		
E	X		X	X	X
F	X	X	X		X
G	X	X	X	X	
H	X	X	X	X	X

Source: From Ref. [5]

For example, the Department of the Navy (DoN) currently uses a two-level rating program, which appraise an employee's performance as being at either an "Acceptable" or "Unacceptable" level (Pattern A).

C. MERIT PROMOTION SYSTEM

If someone is a career or career-conditional employee in the competitive civil service, he/she is covered by the Federal Merit Promotion Policy. A career appointment confers permanent status and career appointees have the greatest possible job protection. A person selected for a continuing position in the federal service is given a career conditional appointment. The first year of service under a career-conditional appointment is a probationary period after which they may be converted to a permanent appointment. The purpose of the Federal Merit Promotion Policy is to ensure the selection of the best-qualified candidates to open positions. It provides for promotions to be made fairly, and

for promotion practices that will support an agency's efforts to select the best qualified persons in any given instance. [Ref. 7: p. 159]

As an agency subject to Performance Management Regulations issued by the Office of Personnel Management (OPM), the DoD may promote, demote, or reassign a career or career-conditional employee because responsibility for the operation of merit promotion programs rests with individual agencies. Each agency is required to have a merit promotion plan which conforms to OPM requirements and details how promotions are made in the agency.

A promotion is a change to a higher grade and should not be confused with periodic "within-grade increases" or "quality step-increases," which provide salary increases within the scheduled rates of the grade. Opportunities for advancement or promotions often occur when new positions are established because of reorganization, when program responsibilities are added, or when an employee vacates a position. Competition among employees is generally required. To be eligible for promotion employees generally must meet the position's qualification requirements and, if applicable, time-in-grade requirements, the time-after-competitive-appointment restriction, and requirements for fully successful performance. [Ref. 6: p. 230]

Merit promotion programs must conform to the following requirements:

- Each agency must establish procedures for promoting employees that are based on merit and are available in writing to candidates. Actions under a promotion plan - whether identification, qualification, evaluation, or selection of candidates - must be made without regard to political, religious, or labor organization affiliation or non-affiliation, marital status, race, color, sex, national origin, non-

disqualifying physical handicap, or age, and must be based solely on job-related criteria;

- Areas of consideration must be sufficiently broad to ensure the availability of high quality candidates, taking into account the nature and level of positions covered;

- To be eligible for promotion or placement, candidates must meet the minimum qualification standards;

- Selection procedures will provide for management's right to select or not select from among a group of best qualified candidates. They will also provide for management's right to select from other appropriate sources, such as employment priority lists, reinstatement, transfer, handicapped, or Veteran Readjustment Act eligibles;

- Administration of the promotion system will include record keeping and the provision of necessary information to employees and the public, ensuring that individuals' rights to privacy are protected. A temporary record of each promotion must be maintained to allow reconstruction of the promotion action, including documentation on how candidates were rated and ranked. [Ref. 8]

No employee must receive a promotion unless his or her current rating of record is "Fully Successful" (level 3) or higher. In addition, no employee may receive a career ladder promotion who has a rating below "Fully Successful" on a critical element that is also critical to performance at the next higher grade of the career ladder. [Ref. 8: pp. 226-229]

D. PAY RATES AND SYSTEMS

There are various pay systems used by the federal government that are also applicable to the DoD civilian workforce. Most federal employees are paid under one of

the two main government pay systems: (1) the "general schedule" (GS) pay system, which sets specific salary levels for federal white-collar workers, or (2) the wage system, which pertains to the government's craft and trade (blue-collar) workers. Both GS and wage system (WS) rates are established and adjusted annually pursuant to law and implementing regulations. In addition, there are a number of other pay schedules and salary systems that govern the amount of compensation paid to certain groups of government employees. Separate pay-setting procedures are in place, for example, for congressional and judicial employees, as well as Executive Level, Senior Executive Service, Senior Level, scientific professional, administrative law judges, certain medical personnel, and other government workers [Ref. 6: p. 7]. Within the Department of Defense, the Civilian Personnel Management Service, Wage-Setting Division, is designated the lead agency for coordinating pay issues for the DoD civilian workforce [Ref. 5]. Table 2.6 displays the distribution of civilian employees by pay plan and agency in 1999. Note that in line with the technical and professional nature of the DoD workforce, over two-thirds of all employees are in the GS pay system.

Table 2.6. Distribution of DoD Civilian Employees by Pay Plan and Agency (February 1999)

Pay Plans	Army		Navy		Air Force		Other DoD		Total	
	Number	%	Number	%	Number	%	Number	%	Number	%
GS	162,559	72.7	123,850	65.4	103,749	65.2	82,941	73.8	473,099	68.9
WS	43,593	19.5	38,943	20.5	50,446	31.7	15,479	15.1	148,461	21.7
Other	17,589	7.8	26,703	14.1	4,943	3.1	15,805	11.1	65,040	9.4
Total	223,741	100	189,496	100	159,138	100	114,225	100	686,600	100

Source: After Ref. [4]

1. General Schedule (GS)

The general schedule is the main pay system that sets the pay rates for employees in most "white-collar" positions. The GS pay system covers more than two-thirds of the federal workforce. Basically, the general schedule is composed of 15 grades, or salary levels. Each grade includes ten steps through which employees advance based on satisfactory job performance and length of service. For all GS grades, waiting periods to be advanced to each higher step (i.e., qualifying for a "within-grade increase") are as follows: 52 calendar weeks to be advanced to steps 2, 3, and 4; 104 calendar weeks to be advanced to steps 5, 6, and 7; and 156 calendar weeks to be advanced to steps 8, 9, and 10.

In most cases, a GS employee's base pay reflects the pay rate specified for the position's grade and step in the locality where the worker is employed. Supervisors of other GS employees ordinarily are classified at least one grade higher than those employees. However, this does not necessarily mean that supervisors will be paid more than each of their subordinates will. The salaries of GS employees are fixed by law. [Ref. 6: p. 8]

2. Wage System (WS)

In contrast to the GS pay rates, the pay of the federal government's wage system employees (blue-collar) is fixed as an hourly rate by the lead agencies in accordance with the procedures established under Title 5 of The United States Code. Pay rates for wage

system employees are set as an hourly rate, and are legally required to be adjusted from time to time consistent with the public interest in accordance with prevailing rates. The most common wage system schedule, the wage grade (WG) schedule used for most non-supervisory workers contains 15 grades. Each of the grades includes 5 steps, which are set at four percent increments.

The wage system's prevailing rate determinations are made on the basis of surveys of rates paid by private employers in each local wage area for work similar to that performed by federal wage employees. Wage schedules are adjusted at different times of the year according to when a lead agency conducts the annual wage survey in each individual wage area. [Ref. 6: p. 8]

THIS PAGE INTENTIONALLY LEFT BLANK

III. LITERATURE REVIEW

This chapter provides a brief review of human capital theory. It also reviews six past research efforts on the payoff to graduate education. These consist of two studies of Wise (1975), two studies of J. Medoff and K. Abraham (1980; 1981), one of Bruce Dunson (1985), and one of S. Mehay and W. Bowman (1999). This review is important for understanding earlier attempts to analyze the effect of education on worker performance, and for specifying the econometric models in this thesis.

A. HUMAN CAPITAL THEORY

As with other types of investments, an investment in human capital entails costs that are borne in the near term with the expectation that benefits will accrue in the future. Generally speaking, the costs to the individual of adding to one's human capital through education and training programs can be divided into three categories:

- Out-of-pocket or direct expenses include tuition costs and expenditures on books and other supplies;
- Foregone earnings are another cost, because during the investment period it is usually impossible to work, at least full-time;
- Psychic losses are a third kind of cost incurred, because learning is often difficult and tedious.

In the case of educational and training investments by individuals, the expected returns are in the form of higher future earnings and increased job satisfaction over one's lifetime.

The basic human capital investment model assumes that people are utility maximizers and take a lifetime perspective when making choices about education and training. For this reason, individuals are assumed to compare the near-term investment costs (C) with the present value of expected future benefits when making a decision about additional schooling. Investment in additional schooling is attractive if the present value of future benefits (B) exceeds costs:

$$\frac{B_1}{1+r}+\frac{B_2}{(1+r)^2}+\dots\dots\dots+\frac{B_T}{(1+r)^T}>C$$

where r is the interest (discount) rate. Utility maximization requires that people continue to make additional investments in human capital as long as the above condition is met and to stop only when the (marginal) benefits of additional investments are equal to or less than the additional (marginal) costs [Ref. 9: p. 289].

In the case of graduate education, an individual invests in such a program expecting higher future earnings, promotion to higher levels in the organization in which s/he works, or other pecuniary and non-pecuniary benefits. We can show potential alternative earnings streams with or without graduate education as in Figure 3.1, which compares the age-earnings profile for a Master's degree to that of the next best alternative, a Bachelor's degree only.

According to human capital theory, we can classify education/training into two categories: general and firm specific [Ref. 10]. General education/training increases an individual's productivity to any number of potential employers at the same time. A

Master's in Business Administration (MBA) is a good example of general education. On the other hand, firm-specific education increases an individual's productivity for the current employer/organization but not in other firms. An example would be training in a specific firm's accounting or computer system.

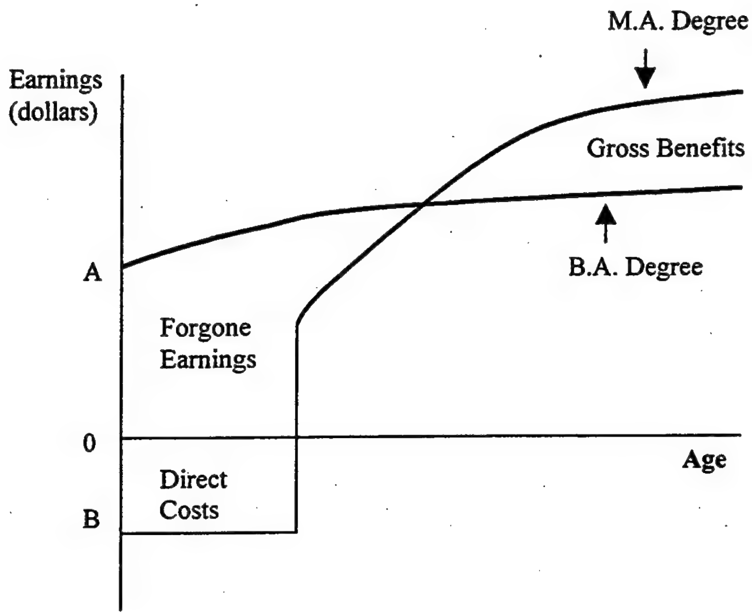

Figure 3.1 Alternative Earnings Streams

The difference between the two types of training is in who pays for the training. Because general training is easily transferred to another firm, the firm has no incentive to pay for this type of training. If the firm provides general training then the individual pays for the training through lower wages so the firm can recoup the cost of the training. Specific training is paid for by both the individual and the firm. The firm will pay the individual a wage equal to its competitors during the training period because specific training does not provide the individual with skills that would be marketable at another

firm. However, after the training period the firm will be compelled to increase the wage to reduce the incentive for the individual to quit. [Ref. 9: pp. 160-61]

B. PREVIOUS STUDIES ON GRADUATE EDUCATION

The effects of graduate education on individual job performance have not been investigated directly except in one study by Bowman and Mehay. However, other studies have explored the relationship between human capital and earnings or between experience and earnings and have included the effects of graduate education. Studies on returns to investment in human capital have revealed clearly that more educated people earn more than those with less education. Some researchers argue that the positive relationship arises because educational attainment enhances an individual's on-the-job performance (productivity), which leads to high levels of earning. Others disagree with this explanation, showing evidence that, even though human capital and earnings are positively correlated, there is no positive correlation between human capital and measured job performance.

In 1975, David A. Wise conducted two studies on the relationship between personal attributes, academic achievement and job performance [Ref. 11; 12]. He specifically investigated the correlation between academic achievement and job performance using data on individuals working in a large U.S. manufacturing firm characterized by a hierarchical structure. The data were restricted to 1,300 white, male, college graduates with different levels of academic achievement. The sample was based on technical and non-technical personnel who worked in a particular environment and

performed similar tasks and who were no older than 30 years old when hired. Age was used to compute pre-firm experience, which was assumed to have a substantial effect on individual job performance. The data were augmented by academic and non-academic individual attributes such as socioeconomic background, high school and college non-academic activities, tastes for job security, academic performance, college attended, Master's degree, rank in graduate school class, and employment goals.

Wise chose salary and probability of promotion, respectively, in his two studies as measures of job performance, based on the assumption that differences in individual job performance are reflected in measures of success within the firm. He then used OLS techniques to estimate a salary regression model, and maximum likelihood techniques (logit) to estimate a promotion model. In both studies, he used the same explanatory variables.

The coefficient estimates obtained from both studies had the same signs and comparable magnitudes. But calculated promotion probabilities suggested a somewhat larger effect of obtaining a master's degree, even with low class rank of achievement, than was implied by rate of salary increase figures. The salary model not only showed that academic achievement is a significant determinant of job performance but also that mastery of academic subject matter contributed to an individual's ability to perform job-related tasks. On one hand, according to his salary model, obtaining a Master's degree has almost no effect on an individual's rate of salary increase, unless he/she graduates at least in the top third of his class. On the other hand, the results suggested a considerably larger effect of the Master's degree on earnings for engineering or science majors than for

business administration majors. Wise's promotion model, however, yielded consistent results. Promotion was found to increase with college selectivity, college GPA, and class rank in graduate school. Wise also found that non-academic ("affective") attributes such as leadership ability, imaginative thinking, expression of one's ideas and desire for job security were as significant as academic abilities in determining job performance.

The results that Wise obtained were not inconsistent with the possibility that education does nothing to enhance productive ability, but rather only serves a screening purpose. However, he suggested that his measures of educational achievement are not only related to job performance, but also that the knowledge gained in the educational process actually contributed to productive ability.

In contrast to Wise, James L. Medoff and Katherine G. Abraham provided evidence that there was no positive correlation between "human capital" and "job performance" in two studies [Ref. 13; 14]. In both studies, they examined the causal relation between experience, performance and earnings among managerial and professional employees. For their first study, they used data drawn from the personnel records of two large corporations in the U.S. manufacturing sector. The corporations provided computerized personnel records for virtually all the members of their exempt workforce. For the analysis data were restricted to white, male, active, full time, regular, domestically based employees. The final data set consisted of the employees in jobs categorized as managerial or professional under the Equal Employment Opportunity Commission's job classification scheme. The data contained information on each employee's education, birth date, service date, current physical work location, most recent

performance ratings, and current salary. The schooling information was used to categorize individuals by highest level of educational attainment: less than high school, high school diploma, bachelor's degree, master's or law degree, or doctorate.

Medoff and Abraham first specified a standard semi-log salary model where the independent variables were highest level of educational attainment, pre-company experience, company service, performance ratings, grade level dummies, and region dummies. They ran the model three times introducing grade level dummies in the second run and performance ratings in the third. Table 3.1 shows their basic results. Estimations obtained from the first model (column 1, Table 3.1) without grade level and performance rating variables indicated that, with pre-company experience and company service held constant, individuals with advanced degrees received substantially higher salaries than individuals with less education. Controlling for educational attainment and company service, there was a positive association between salary and pre-company experience and, controlling for schooling and pre-company experience, there was a positive association between salary and company service. This effect weakened with length of service but did not vanish within the set of feasible differences in years of service.

When Medoff and Abraham introduced grade level dummies into the model in the second run (column 2, Table 3.1) relatively little of the return to educational attainment took the form of higher within-grade-level earnings. Controlling for pre-company experience and company tenure, systematic within-grade-level earnings differences accounted for an average of 13 percent of the total earnings differential between advanced degree holders and those with only a bachelor's degree. Based on the results,

the authors suggested that those with higher educational attainment earn more than less educated workers almost entirely because they are initially assigned to jobs in grade levels with higher mean earnings.

In the next step, Medoff and Abraham added performance-rating dummies into the model (column 3, Table 3.1). The underlying question for this addition was why workers with more education, more pre-company experience, and more company tenure (on-the-job training) had higher within-grade-level earnings. One possible explanation

Table 3.1. Earnings Function Estimates from Medoff and Abraham

Independent Variables	(1)[a] Coefficient	(1)[a] S.E.	(2)[a] Coefficient	(2)[a] S.E.	(3)[a] Coefficient	(3)[a] S.E.
Less than high school diploma	-.247	.010	-.075	.007	-.077	.007
High school diploma	-.131	.005	-.013	.003	-.012	.003
Master's or law degree	.104	.010	.022	.006	.020	.006
Doctorate	.214	.025	.051	.016	.054	.016
Pre-company experience (year)	.043	.008	.023	.005	.027	.005
Pre-company experience square	-.003	.003	-.003	.002	-.004	.002
Company service (year)	.202	.008	.087	.006	.088	.006
Company service square	-.031	.002	-.013	.001	-.013	.001
Performance rating 1[b]	---	---	---	---	-.053	.027
Performance rating 2[b]	---	---	---	---	-.039	.006
Performance rating 4[b]	---	---	---	---	.025	.003
Region dummies (3)	yes		yes		yes	
Grade level dummies (18;11)	no		yes		yes	
Constant	yes		yes		yes	
R^2	.356		.741		.747	
SEE	.144		.091		.090	

[a] (1) No controls for grade level and performance rating
(2) Conrols for grade level, no controls for performance rating
(3) Controls for grade level and performance rating
[b] Performance ratings: 1- Not acceptable, 2- Acceptable, 3- Good, 4- Outstanding.
Source: After Ref (13).

was that such workers had acquired valuable skills during their years in school and in the labor force and as a result their productivity (job performance) exceeded that of less educated, less experienced workers in the same grade level. If this explanation were valid, the authors would have expected that the introduction of performance rating dummies into the semi-log salary equation with grade level controls would move the estimated coefficients of the schooling, pre-company experience, and company tenure variables toward zero. However, although higher rated performance was associated with significantly and substantially higher earnings, introduction of performance rating dummies had virtually no effect on the relevant education and experience (on-the-job training) variables. Thus, Medoff and Abraham concluded that within groups of similar jobs, despite the positive correlation between human capital and earnings, there did not appear to be a positive correlation between human capital and job performance.

To enhance their findings, the authors offered another way of looking at the earnings-performance nexus. They categorized employees' salaries and performance ratings into three levels: below average, average, above average. Then, they specified two multinomial logit models to estimate the effects of education, pre-company experience, and company service on the probability of an individual being in each of the salary categories and in each of the performance categories. If the higher within-grade-level earnings of those with more education and more experience had been a reflection solely of the higher relative productivity of such workers, the authors would expect the estimated coefficient in the salary category model to equal the estimated coefficients in the performance category model. In fact, the estimated coefficients in the salary category

model were found to be markedly different from those in the performance category model. The results suggested that those with less than a college education appear to have a much lower probability of being in one of the top two salary categories than do those whose highest degree is a bachelor's degree, but an equal or higher probability of being in one of the top two performance categories. Those with advanced degrees, on the other hand, were found to have a substantially higher probability of being in one of the highest two earnings categories than those whose final degree was a Bachelor's degree. However, these same people had a substantially higher probability at one company and a substantially lower probability at the other of being in one of the top two performance categories. [Ref. 13][1]

In his study titled "Pay, Experience, and Productivity: The Government-Sector Case," Bruce Dunson investigated the question of whether the findings of Medoff and Abraham for private-sector workers would apply to federal government workers [Ref. 15]. The study replicated one of the Medoff-Abraham tests to examine whether differences in earnings for a select group of civilian middle managers and professionals in the Department of Defense could be explained by the hypothesis that more experienced workers were more productive workers.

For the study, he used the Department of Defense Civilian Master and Transaction File, which contained the personnel records of all civilian employees in the DoD. This is the same file that we use in this thesis. The analysis in his study was based

[1] Medoff and Abraham replicated their study in 1981 using personnel records of a different U.S. manufacturing corporation. The results they found in this second study were strikingly similar to those in the first one. [Ref. 14]

on the data for white males working full time in the continental U.S. with general merit 13, 14, and 15 pay plans (grade levels). Each file contained information on an employee's education, birth date, service date, and region of country where employed. The schooling information in each file was used to categorize individuals by highest level of educational achievement. The categories were less than high school, high school diploma, bachelor's degree, master's or professional degree, and doctorate. As an index of employee performance, this study used the performance rankings required by the Civil Service Reform Act of 1980 and its implementing regulation. The performance ratings were 1 = outstanding; 2 = exceeds fully successful; 3 = fully successful; 4 = minimally successful; 5 = unsatisfactory. Since very few people were rated as unsatisfactory, only categories 1 through 4 were used in the analysis.

In the analysis, a standard semilog earnings equation of the following form was estimated where Y was annual salary, X represented a vector of personal characteristics,

$$\ln Y = XB + e$$

B was a vector of parameters to be estimated, and e was an error term. As in Medoff and Abraham the estimation was done in three stages: (1) no controls for performance ratings and grade levels; (2) control for grade levels; (3) control for both performance ratings and grade levels.

In all agencies (Army, Navy, Air Force, and Other DoD), when education and differences in age and region of the country were controlled, the more experienced employees earned more than their less experienced peers. Dunson found that M.A. and

Ph.D. degree holders generally earned more than those with a B.A. degree did because they were in grades with higher mean earnings. Within-grade earnings differentials were consistently smaller for those with a Master's or professional degree compared to those with a B.A. only. Table 3.2 shows the results of the Dunson study.

In the study, Dunson's main assumption was that the performance ratings reflected relative productivity. The performance variables, when statistically significant, produced results that were consistent with this assumption. Controlling for education level, experience and grade, persons receiving higher rated performances on average earned more compared with those with lower performance evaluations.

The major finding of the study was that performance did not seem to be a significant mediating factor in the positive within-grade-level association between labor force experience and earnings. In this regard the findings were consistent with those observed by Medoff and Abraham. It appeared also to be true for similar groups of jobs in the government sector that, although human capital and earnings were positively correlated, there was no positive correlation between human capital and performance. [Ref. 15]

Table 3.2. Earnings Equation Estimates from Dunson

Independent Variable	Army (1)[a]	Army (2)[a]	Army (3)[a]	Navy (1)	Navy (2)	Navy (3)
Less than high school degree	-0.106 (0.024)[b]	-0.045 (0.013)	-0.046 (0.013)	-0.007 (0.007)	-0.029 (0.004)	-0.031 (0.004)
High school degree	-0.066 (0.003)	-0.032 (0.002)	-0.032 (0.002)	-0.054 (0.004)	-0.029 (0.002)	-0.029 (0.002)
Master's or professional degree	0.04 (0.003)	0.008 (0.002)	0.008 (0.002)	0.032 (0.004)	0.001 (0.002)	0.001 (0.002)
Doctorate	0.111 (0.006)	0.029 (0.003)	0.028 (0.003)	0.089 (0.068)	0.011 (0.004)	0.011 (0.004)
Average age upon initial employment by government/10	-0.0006 (0.013)	0.035 (0.007)	0.036 (0.007)	0.055 (0.013)	0.059 (0.006)	0.061 (0.006)
Average age^2 upon initial employment by government/100	0.005 (0.002)	-0.009 (0.001)	-0.001 (0.001)	-0.003 (0.002)	-0.004 (0.001)	-0.004 (0.001)
Years of government experience/10	0.216 (0.008)	0.136 (0.004)	0.136 (0.004)	0.218 (0.004)	0.146 (0.004)	0.149 (0.004)
Years of government experience^2 /100	-0.026 (0.002)	-0.014 (0.009)	-0.014 (0.009)	-0.027 (0.002)	-0.017 (0.009)	-0.018 (0.009)
Performance rating 4[c]	...	...	0.005 (0.008)	...	...	-0.005 (0.006)
Performance rating 3[c]	...	...	-0.012 (0.001)	...	...	-0.009 (0.001)
Performance rating 1[c]	...	...	0.003 (0.002)	...	...	0.009 (0.002)
Constant	Yes	Yes	Yes	Yes	Yes	Yes
Region dummies	Yes	Yes	Yes	Yes	Yes	Yes
Grade level (13,14,15)	No	Yes	Yes	No	Yes	Yes
R^2	0.299	0.799	0.802	0.216	0.841	0.842

a.(1) No controls for performance ratings and grade levels.
(2) Control for grade level.
(3) Control for both performance ratings and grade levels.

b.Standard errors in parentheses.

c. Performance ratings: (1) outstanding; (2) exceeds fully successful; (3) fully successful; (4) minimally successful.

Source: From Ref. (15)

Table 3.2 (Continued)

Independent Variable	Air Force			Other DoD		
	(1)	(2)	(3)	(1)	(2)	(3)
Less than high school degree	-0.07 (0.029)	-0.039 (0.014)	-0.042 (0.014)	-0.047 (0.057)	-0.016 (0.024)	-0.026 (0.023)
High school degree	-0.067 (0.004)	-0.033 (0.002)	-0.035 (0.002)	-0.024 (0.008)	-0.018 (0.003)	-0.019 (0.003)
Master's or professional degree	0.042 (0.004)	0.003 (0.002)	0.003 (0.002)	0.065 (0.008)	-0.006 (0.003)	-0.006 (0.003)
Doctorate	0.149 (0.007)	0.038 (0.004)	0.038 (0.004)	0.132 (0.016)	0.014 (0.007)	0.013 (0.007)
Average age upon initial employment by government/10	0.031 (0.016)	0.051 (0.008)	0.048 (0.008)	0.037 (0.037)	0.074 (0.015)	0.082 (0.015)
Average age^2 upon initial employment by government/100	0.001 (0.003)	-0.002 (0.001)	-0.002 (0.001)	0.002 (0.006)	-0.006 (0.002)	-0.007 (0.002)
Years of government experience/10	0.207 (0.01)	0.136 (0.005)	0.139 (0.005)	0.099 (0.019)	0.08 (0.008)	0.078 (0.008)
Years of government experience^2 /100	-0.022 (0.002)	-0.014 (0.001)	-0.014 (0.001)	-0.005 (0.004)	-0.003 (0.002)	-0.003 (0.002)
Performance rating 4	...	...	0.007 (0.007)	...	...	-0.003 (0.023)
Performance rating 3	...	...	-0.006 (0.002)	...	...	-0.014 (0.003)
Performance rating 1	...	...	0.008 (0.002)	...	...	0.012 (0.004)
Constant	Yes	Yes	Yes	Yes	Yes	Yes
Region dummies	Yes	Yes	Yes	Yes	Yes	Yes
Grade level (13,14,15)	No	Yes	Yes	No	Yes	Yes
R^2	0.322	0.844	0.846	0.247	0.872	0.876

a.(1) No controls for performance ratings and grade levels.
(2) Control for grade level.
(3) Control for both performance ratings and grade levels.
b.Standard errors in parentheses.
c. Performance ratings: (1) outstanding; (2) exceeds fully successful; (3) fully successful; (4) minimally successful.
Source: From Ref. (15)

Various weaknesses of the Dunson study can be mentioned. First of all, the data file used for the analysis is not described adequately. For example, grade level dummies are introduced in the second step of his model but there is no explanation of why only

pay grades 13, 14, and 15 are included in the sample. Additionally, all educational attainment variables (less than high school, high school diploma, Bachelor's degree, Master's or professional degree and Doctorate) were included in the sample. It is questionable to compare high school dropouts with Master's or Ph.D. degree holders. It would be better to restrict the data to individuals with a Bachelor's degree or above.

In a recent study, Bowman and Mehay examined the specific relationship between graduate education and on-the-job performance for professional employees in a single, large, hierarchical organization [Ref. 16]. The study examined the effect of graduate education on job success using a unique micro database consisting of officers in the U.S. Navy. The study concentrated on promotion as the performance measure; however, information on supervisor evaluations was also used. Their promotion model focused on promotion to grade 4, which is the first significant control point in an officer's career and involves an "up-or-out" decision. The basic information was drawn from the Navy's Promotion History File, which provided background information on all officers reviewed for promotion between 1985 and 1990. This file was augmented with supervisors' evaluations (fitness reports) prior to the grade 4 promotion review. There were 4,471 observations in the data file. Officers were classified into two occupational categories: line and staff specialties.

In the empirical model, cognitive abilities were specified as a function of college grade point average, a technical undergraduate degree in science, engineering, or mathematics, or a graduate degree. Proxies for affective skills were based on accession source - the Naval Academy, an ROTC scholarship, Officer Candidate School (OCS), or

the enlisted ranks. Demographic factors, such as gender and race, marital and family status, and fiscal year dummies also were included in the model.

The authors found that the estimated coefficients of an M.A. degree from any source had the expected signs and generally were statistically significant. They used four model specifications. In all specifications, the graduate degree coefficient was positive and significant. But the effect of graduate education was reduced as additional controls, some of which were likely to be correlated with an M.A., were included. When the additional controls were entered in the model, there was a roughly 40 percent drop in the effect of graduate education on promotion.

Of the officers with graduate degrees, the majority (75.1 percent of line officers and 70.8 percent of staff officers) received them via the Navy's funded program, which pays tuition and salary during attendance at graduate school. They stated that the measured effect of funded education would be biased upward if the organization assigned more able persons to graduate school (administrative bias) or if the individuals based their attendance at graduate school on the expected returns (self-selection bias). That is, those who accepted funding viewed the benefits (in the form of higher promotion or better assignments) as exceeding the cost of the additional service time; those who rejected the funded program probably either did not expect to remain in the Navy owing to superior civilian employment opportunities or because they did not like the Navy. They addressed this selection bias issue by using a two-stage bivariate probit model. They first estimated a probit model of the determinants of graduate school attendance, which assumed the attendance was based on expected returns and individual

characteristics such as sex, age, marital status, and race/ethnicity. Their graduate school model included proxies for the likelihood of being selected for the graduate education program.

Their two-stage bivariate probit model provided evidence that a large part of the promotion effects in the single stage models was explained by the selection of more able officers into the graduate education program. For staff officers, for example, the effect of an M.A. fell by 50 percent. Their results are displayed in Table 3.3 and 3.4. Table 3.3 looks at the effect of an M.A. from any source and Table 3.4 looks at the effect of M.A.'s fully funded by the Navy.

Table 3.3. Coefficient of Any Master's Degree in Single Stage and Bivariate Probit Models in Bowman and Mehay Study

	(1) No controls for ability/performance	(2) Controls for ability/performance	(3) Bivariate Probit
Line Officers	.376 (.073)[a] [.098][b]	.265 (.065) [.065]	.248 (.075) [.065]
Staff Officers	.503 (.063) [.145]	.376 (.073) [.089]	.188 (.108) [.051]

[a]Standard errors in parentheses
[b]Marginal effect in brackets
Source: From Ref. (16)

The authors also looked at the effect of the fully funded graduate education program. The results revealed that for line officers the return to a funded degree was nearly double what it was for any M.A., and for staff officers it was about 20 percent higher (compare column 1 of the tables 3.3 and 3.4). Thus, the positive return to an M.A.

observed in single stage estimates appeared to be confined to the funded degree program. However, comparing Tables 3.3 and 3.4 suggested that selection bias was greater for the funded program than for other M.A. program. Positive selection reduced the return to any Master's degree by about one-third for line officers, and it reduced the return for funded degrees by nearly by one-half. For staff officers, the return to any M.A. was reduced by two-thirds, but by nearly three-fourths for funded degrees. Two conclusions emerged from their analysis: (a) both firm specific and general types of investments appear to yield a positive return to the officers in the Navy; and (b) selection or ability bias accounts for a large portion of the measured return to Master's degrees in the Navy.

Table 3.4. Coefficient of Fully Funded Master's Degree in Single Stage and Bivariate Probit Models in Bowman and Mehay Study

	(1) No controls for ability/performance	(2) Controls for ability/performance	(3) Bivariate Probit
Line Officers	.605 (.067)[a] [.148][b]	.460 (.074) [.093]	.250 (.057) [.068]
Staff Officers	.615 (.072) [.172]	.447 (.086) [.100]	.154 (.065) [.046]

[a]Standard errors in parentheses
[b]Marginal effect in brackets
Source: From Ref. (16)

IV. DATA AND METHODOLOGY

This chapter describes the data set used in this study and explains the methodology for constructing multivariate performance models used to measure the effects of graduate education on job performance. It also provides descriptive statistics about each data set used in the models. Section B describes each of the four models (salary, promotion, retention, and performance rating) and how they were constructed.

A. DATA DESCRIPTION

The data used in this study were drawn from DoD Civilian Data Files provided by the Defense Manpower Data Center (DMDC). Two different data files are available for DoD civilian personnel: (1) an inventory (current status) file, and (2) a transaction (dynamic) file. Both files contain similar data elements. Appendix A provides a list of those data elements as of January 1998. These two files cover personnel paid from appropriated funds in all Defense agencies except the National Security Agency, the National Imagery and Mapping Agency, and the Defense Intelligence Agency. They exclude coverage of foreign national direct and indirect hire civilian employees outside the 50 states and the District of Colombia. For our research, DMDC merged these two files into one file including only selected data elements. These elements were selected based on their use, in either identical or similar forms, in prior studies on graduate education and job performance. The new data file was restricted to full-time, career, and career conditional employees with at least BA/BS degrees and who were paid under the General Schedule (GS) or General Management (GM) pay systems in September 1986.

These same individuals were followed by two-year intervals until 1998. The file also provided a last snapshot in February 1999. This data file was converted into a SAS (Statistical Application Software) file and analyzed on the NPS mainframe computer system.

The General Schedule (GS) and General Management systems were chosen for the analysis in this thesis because they are the primary white-collar pay systems and they cover almost two-thirds of the entire defense civilian workforce. Another reason was that their positions have been classified into 18 grades based upon the difficulty and responsibility of the work performed. Grade increases in the system lead to rises in salary, status, and authority.

The data file used in the analysis in this thesis contained 213,482 observations and 41 data elements. These data elements consisted of personnel demographics and background information such as sex, race, age, educational attainment, veteran status, and federal service years, among others. A full list of these data elements is presented in Appendix B. Among the 213,482 employees, 76 percent held BA/BS degrees while 20.9 and 3.1 percent held MA/MS and Ph.D. degrees as their highest educational degree, respectively. Tables 4.1 and 4.2 provide complete descriptive statistics of the raw data.

Table 4.1. Descriptive Statistics, September 1986 Defense Civilian Personnel (Inventory Data)

		Frequency	Percent
Sex	Male	162,339	76.0
	Female	51,143	24.0
	Total	213,482	100.0
Race	White	178,075	83.4
	Black	17,455	8.2
	Hispanic	6,454	3.0
	Other	11,498	5.4
	Total	213,482	100.0
Veteran	Yes	79,296	37.1
	No	134,186	62.9
	Total	213,482	100.0
Agency	Army	82,129	38.5
	Navy*	62,887	29.5
	Air Force	42,546	19.9
	Other DoD	25,920	12.1
	Total	213,482	100.0
Education Level	BA/BS	162,165	76.0
	MA/MS	44,707	20.9
	Ph.D.	6,610	3.1
	Total	213,482	100.0
Pay Plan	GS	174,424	81.7
	GM	39,058	18.3
	Total	213,482	100.0
Supervisory Status	Yes	54,261	25.4
	No	159,221	74.6
	Total	213,482	100.0
Occupational Category	Professionals	112,318	52.6
	Administrative	74,377	34.8
	Technical	14,226	6.7
	Clerical	12,013	5.6
	Other White Collar	548	0.3
	Total	213,482	100.0

*Includes Marine Corps.
Source: DMDC

Table 4.2. Descriptive Statistics, September 1986 Defense Civilian Personnel (Inventory Data)

	Number of observations	Mean
Salary ($)	213,482	$33,331
Federal Service (years)	213,482	12.91
Age (years)	213,482	40.51

Source: DMDC

B. METHODOLOGY

The purpose of this research is to investigate the relationship between graduate education and on-the-job performance of DoD civilian employees. One way to pursue this research is to statistically model the causal relationship between the two factors. However, such a model requires quantifiable measures for graduate education, on-the-job performance, and all other relevant elements that may affect measured on-the-job performance. Yet there appears to be no completely satisfactory way of measuring job performance in DoD, or even of defining it. We therefore assume that differences in job performance across individuals are reflected in the available measures of success within the DoD and that rewards within the DoD are based on job performance, or at least on perceived performance. The measures of job-performance include salary level, promotion, performance ratings, differential between consecutive salaries, time elapsed between consecutive promotions, and retention.

In this study, we chose to focus on four of the aforementioned performance measures; salary level, promotion, performance ratings, and retention. These four measures were the most appropriate job performance indicators we could used to develop performance models with the data at hand. The specifications of these four statistical performance models are presented in detail in the following sections.

We based our performance models on the assumption that individuals with higher educational attainment are more likely to work in higher grade levels. These individuals are likely to have higher earnings, but lower probabilities of promotion. Because the grade levels in GS/GM systems are based upon the difficulty and responsibility of the work performed, higher grade levels call for higher salaries for their occupants. However, promotion probabilities should be lower at higher grades because promotions generally are vacancy driven and there are usually fewer openings at higher levels in the organization.

Based on these assumptions, we analyzed the salary and promotion models with and without controls for grade level. The model with no controls for grade level estimates the overall effect of individual traits, especially educational attainment, on job performance while the model with controls for grade level estimates within-grade effects.

In a second set of models, we ran the same four performance models with a sample restricted to the cohort of employees who were hired in 1986, assuming that they comprised a better sample since they started to work in the same year and had no previous service background in the DoD. These models provide the salary, retention and performance rating experience of new hires in DoD agencies.

1. Salary Model

Numerous studies of returns to investment in human capital have demonstrated quite clearly that more educated workers earn more than those with less education. According to human capital theory, an individual chooses the occupation and level of education that maximizes the present value of his/her expected lifetime earnings. It is generally assumed that education increases an individual's productive capacity to perform job-related tasks. [Ref. 10]

We constructed one of our models on this basic assumption of human capital theory by using salary as a measure of job performance. If we consider that the employee appraisal systems within the DoD are based on merit, we can expect that better performers will earn more. Because grade level largely determines salary, especially in a government organization, it should be controlled for in this kind of model. To see the effects of educational attainment and other relevant variables we used a standard semi-log earnings function:

$$ln(Y) = \beta_0 + \beta X + \varepsilon$$

where

Y = annual salary;

β_0 = a constant term;

X = a vector whose elements capture background characteristics, highest level of educational attainment, federal experience, and other salary determinants;

β = a vector of parameters to be estimated and;

ε = a random error term.

Medoff and Abraham (1980) used a standard semi-log annual earnings function to investigate the relation between earnings and relative performance. Their data set consisted of employees from two large corporations in the U.S manufacturing sector who were white, male, active, full time, regular employees. In their analysis, they included all educational attainment categories (less than high school diploma, high school diploma, Bachelor's degree, Master's or law degree, and Doctorate).

Bruce Dunson (1985) also used a standard semi-log annual earnings function to find the relationship between relative earnings, experience, and rated performance with the same data we used for this study (i.e., DoD civilian workers). He restricted the data to white males in either professional or administrative jobs with grade levels 13, 14, and 15. He also included workers in all educational categories.

Differing from these studies, we restricted our data to only individuals with a Bachelor's degree or higher. This is an important restriction as it is appropriate to compare salary and performance of MA's to BA's, and not to non-college workers. We ran the model in two steps: (1) without controlling for grade levels; (2) controlling for grade levels to investigate within-grade effects of explanatory variables. The second step was applied to only the 1986 inventory sample. We included "grade level" as a continuous variable in the second step. In this salary model, ordinary least squares (OLS) techniques were used to estimate the parameters because the dependent variables, log of

SALARY, was a continuous variable. The reason we used a semi-log function is it provides the percentage effect of a change in each of the individual explanatory variables on the dependent variable. Table 4.3 displays definitions of the dependent and independent variables used in this model.

Our dependent variable for this model is the log of annual salary for the year 1986. We included background variables such as sex and race to account for possible differences in the quality of schooling or in the types of college majors of women and minorities. We included educational attainment with the expectation that individuals with higher education would earn more. Similarly, experience variables were included with the expectation that individuals with more experience would earn more. Two types of experience are modeled: experience in one's federal job, and experience in the civilian workforce prior to entering federal employment. Because regional economic conditions have different effects on the salary, metropolitan area status and region dummy variables were also added to the model. Supervisory status and occupational category variables were also added to the model with the expectation of different effects on salary.

Individuals less than 22 years old and above 65, and those with annual salaries lower than $5,000 were deleted from the data file. Individuals with missing values for the analysis variables also were excluded from the model. After these adjustments, 199,070 observations remained in the data file. Table 4.3 shows descriptive statistics for this sample. Table C.1 in Appendix C shows descriptive statistics for the "new hires" sample.

In our sample for the salary model, men comprise 76.8 percent of the sample and whites 83.8 percent. The majority of the sample (76.4%) has only a Bachelor's degree,

while Master's degree and Ph.D. degree holders comprise 20.6 and 3.1 percent of the file, respectively. Mean annual salary for this sample is $33,498. Mean federal service and mean prior experience are 11.9 and 6.1 years, respectively.

Table 4.3 Variable Definitions and Descriptive Statistics for Salary Model (N = 199,070)

Variable Name	Variable Description		
Dependent Variable			
ln (SALARY)	Log of annual salary for the year 1986		
Independent Variables		N	%
FEMALE	1 = Female 0 = Male	46,131 152,939	23.2 76.8
BLACK	1 = Black 0 = Not Black	16,262	8.2
HISPANIC	1 = Hispanic 0 = Not Hispanic	5,693	2.9
WHITE*	1 = White 0 = Not White	166,732	83.8
OTHERACE	1 = Other Race 0 = Not Other Race	10,383	5.2
VETERAN	1 = Veteran 0 = Not Veteran	73,330 125,740	36.8 63.2
BA_BS86*	1 = Individual has a Bachelor's degree in 1986 0 = Individual doesn't have a Bachelor's degree in 1986	152,074	76.4
MA_MS86	1 = Individual has a Master's degree in 1986 0 = Individual doesn't have a Master's degree in 1986	40,922	20.6
PHD86	1 = Individual has a Ph.D. degree in 1986 0 = Individual doesn't have a Ph.D. degree in 1986	6,074	3.1
METROP86	1 = Metropolitan Area 0 = Not Metropolitan Area	162,189 36,881	81.5 18.5
NEWENG	1 = Census Region is New England 0 = Census Region is not New England	8,877	4.5
MIDATLAN	1 = Census Region is Mid Atlantic 0 = Census Region is not Mid Atlantic	22,624	11.4
EASTNC	1 = Census Region is East North Central 0 = Census Region is not East North Central	22,321	11.2
WESTNC	1 = Census Region is West North Central 0 = Census Region is not West North Central	9,641	4.8
SOUTHAT	1 = Census Region is South Atlantic 0 = Census Region is not South Atlantic	64,154	32.2

Table 4.3. (cont.)

EASTSC	1 = Census Region is East South Central 0 = Census Region is not East South Central	13,043	6.6
WESTSC	1 = Census Region is West South Central 0 = Census Region is not West South Central	16,825	8.5
MOUNTAIN	1 = Census Region is Mountain 0 = Census Region is not Mountain	10,085	5.1
PACIFIC*	1 = Census Region is Pacific 0 = Census Region is not Pacific	31,500	15.8
SVISOR	1 = Individual has supervisory position 0 = Individual doesn't have supervisory position	50,281 148,789	25.3 74.7
PROF	1 = Occupational category is Professional 0 = Occupational category is not Professional	105,946	53.2
ADMIN	1 = Occupational category is Administrative 0 = Occupational category is not Administrative	69,114	34.7
TECH*	1 = Occupational category is Technical 0 = Occupational category is not Technical	12,930	6.5
CLERK	1 = Occupational category is Clerical 0 = Occupational category is not Clerical	10,564	5.3
OTHERWC	1 = Occupational category is Other White Collar 0 = Occupational category is not Other White Collar	516	0.3
		N	**Mean**
FEDYEAR	Federal Service in years	199,070	11.91
SFEDYEAR	Square of Federal Service	199,070	227.27
PRIEXP	Prior Experience in years	199,070	6.09
SQPRIEXP	Square of Prior Experience	199,070	90.95
SALARY	Annual Salary for 1986	199,070	33498.24
ln(SALARY)	Log of Annual Salary	199,070	10.35
GRADE86	Pay Grade in 1986	199,070	10.79

* Base Case Variable

2. Promotion Model

When salary is used as a measure of job performance (or productivity), there is an implicit assumption that salary is somehow adjusted to match individual performance. But in practice, salaries are normally attached to positions in a firm, and not to the

individuals filling them at any particular time. In many large organizations, especially in government organizations, each position is assigned a grade level and a "basic salary" or wage is associated with each level. This is sometimes referred to as the "salary structure" of the organization. Normally, the higher the position in the firm hierarchy, the higher the salary. Although an individual's salary is largely determined by the position he/she holds at any given time, this basic salary may be adjusted for years employed, more or less automatically. [Ref. 12]

This suggests that the rate of upward movement of an individual in the organizational hierarchy may be a more direct measure of job performance than is his/her rate of salary increase. This assumes, of course, that persons who are judged by the firm to be "more capable" are promoted faster. Looking at promotions may also yield quantitatively different results than salaries may show, because persons who are not promoted from one level to the next may still receive increases in salary. Thus, differences in grade levels between persons and promotions from one level to the next may suggest greater individual differences in on-the-job performance than are implied by salary differentials. [Ref. 12]

We therefore developed the following promotion model based on the preceding assumptions. We examined federal employees serving in the DoD in 1986 and looked at their promotion histories through 1992. The purpose of choosing a 6-year period was to allow variation over time while keeping a large number of observations for better statistical reliability. The dependent variable PROMOTE for this model was derived by distinguishing those individuals who were promoted at least once between September

1986 and September 1992 from those who were not. The data set provided "date of last promotion" for each federal employee, which is the data element used to construct the dependent variable. If the individual's date of last promotion taken out of the 1992 data set fell between 1986 and 1992, the dependent variable PROMOTE took a value of 1, otherwise it took the value of 0. Because the dependent variable is binary, the probit or logit models of binary outcome are more appropriate estimating procedures than linear multiple regressions. The most important consideration is that the use of a multiple regression model to predict promotion may result in predicted values greater than 1 or less than 0 in some cases. Because such predictions are meaningless, the preferred procedure is to use a non-linear technique, such as probit or logit, which estimate S-shaped curves with asymptotes at the value of 0 or 1 so that all predictions fall inside the range of 0 to 1, meeting the test of making realistic predictions. Because there does not seem to be any clear criterion for choosing one of these specifications over the other, we chose the logistic specification.

The basic logit model can be written as:

$$\boldsymbol{Prob(Promote)}=\beta_o+\beta X+\varepsilon$$

where;

Prob(Promote)= The probability of promotion for individual i,

X= a vector of personal demographics and background characteristics that may influence the promotion behavior,

β= a vector of coefficients for the X factors,

β_o= a constant term, and

ε= an error term.

As a first step in shaping the data used in this model, we excluded federal employees who left DoD by September 1992 because the dates of their last promotions were not available. Next, we restricted the data to federal employees whose educational attainments remained unchanged during the 1986-1992 period. That is, those who attained an additional degree between 1986 and 1992 were excluded because on-the-job performance or grade might have been affected by the additional education. A final restriction was the exclusion of individuals whose age in 1986 were less than 22 or greater than 65. After the restrictions, the sample size for this model equals to 128,069.

In specifying the model, we chose explanatory variables based on the prior research studies cited above in Chapter 3. The promotion model was specified to look at an individual's success in being promoted between 1986 and 1992. The following paragraphs will provide a further explanation of each explanatory variable included in the model.

Much of the literature on promotions uses data provided by individual firms. There are also a few studies using panels of workers. One result found consistently in all studies of promotion is that promotion rates fall with age or experience. Tenure effects on promotion are less consistent across studies, with evidence both for positive and negative effects. Steward and Gudykunst (1982) find positive effects, while Medoff and Abraham

find negative effects (1980) [Ref. 17]. In our model, we controlled for firm-specific experience by including a variable for years of federal service.

Education effects are frequently not significant in prior studies (e.g., Lewis 1986; Hersh 1993), but where significant effects have been found, higher levels of education are associated with a greater likelihood of promotion, particularly at lower levels of education (e.g. Rosenbaum 1979) [Ref. 17]. For our model, we split the educational attainment into three categories; Bachelor's degree only, Master's degree, and Doctorate.

Performance ratings are usually considered as one of the most significant basis for promotion in firms. These ratings should reflect actual performance differentials between employees in a firm, or at least performance differentials as perceived by supervisors. The literature provides evidence that performance ratings are significant indicators of promotion incidence (e.g., Mehay and Bowman (1999); Medoff and Abraham (1980)). Thus, one should control for performance ratings in a promotion model. Performance ratings used in our model have five distinct levels: 1- Unacceptable, 2- Level between unacceptable and fully successful, 3- Fully successful, 4- Level between fully successful and outstanding, and 5- Outstanding. Performance ratings levels were not provided for almost two-thirds of the observations in 1986. Thus we measured each individual's performance rating in 1988.

Some studies have found that women have higher promotion rates than men (Gehart and Milkovich 1989; Hersh 1993), while other studies have found that women have lower promotion rates (Cabral et al. 1981), and yet others have found that promotion rates for men and women are equal (Lewis 1986) [Ref. 17]. Because most of these studies

are based on data for one or two firms, conclusions drawn by the authors may be specific to the firm under consideration, which may explain inconsistencies in their findings. We added the variable of FEMALE to test for gender differentials in promotion.

Veteran's preference offers substantial advantages on entrance examinations for federal employment, but no explicit advantage in the promotion process. Despite preferential hiring treatment, veterans appear to earn less than comparable non-veterans in the federal service (Corazzini 1972, Lewis and Emmart 1984, Longs 1976, Taylor 1979). Taylor (1979) has argued that veterans' advantage in initial placement puts them into jobs for which they are not fully qualified, and that consequently they are not promoted as rapidly as non-veterans [Ref. 18]. Thus, the variable VETERAN was included to test for potential promotion differentials between veterans and non-veterans.

Another significant factor that should be considered in a promotion model is the promotion opportunities available to individuals. Each individual is considered for promotion only when a position becomes vacant due to promotion or separation of the incumbent or when a new position is created. Even though individuals may have the same characteristics, they will not have the same likelihood of being promoted primarily because they are working in different locations throughout the organization or in different occupations. Vacancies can differ widely by activity and occupation. Furthermore, promotion chances should decline at higher grades since there are usually fewer jobs at those levels. The relationship may not be linear, however. In the case of DoD employees, we believe that most MA/MS degree holders occupy higher grade levels. Thus, the model must control for promotion opportunities. This is accomplished by including dummy

variables for supervisory status, occupational group, functional area, and grade level. Occupational groups were split out into five categories; professional, administrative, technical, clerical, and "other" white collar. Functional areas were divided into fleet, intelligence and communication, training and education, medical, and administrative activities. Finally, in accordance with our main assumption stated above in the methodology section, grade level was controlled in the second stage of this model. The model also included several dummy variables for race or ethnicity to capture differences that stem from different social backgrounds. Race ethnicity is defined as BLACK, HISPANIC, WHITE, and OTHERACE.

Table 4.4 defines the variables included in the model and provides descriptive statistics. As seen in the table, 70,442 of the 128,069 observations were promoted during 1986-1992, which accounts for 55 percent of all observations. Bachelor's degree holders comprise 74.6 percent of the sample while Master's degree and Ph.D. degree holders account for 22.2 and 3.2 percent, respectively. Mean year of federal service is 11.5 years. Table C.2 in Appendix C gives descriptive statistics for the "new hires" sample.

Table 4.4. Variable Definitions and Descriptive Statistics for Promotion Model (N=128,069)

Variable Name	Variable Description	N	%
Dependent Variable		**N**	**%**
PROMOTE	1 = Promoted by 1992	70,442	55.0
	0 = Not promoted by 1992	57,627	45.0
Independent Variables			
FEMALE	1 =Female	27,547	21.5
	0 = Male*	100,520	78.5
BLACK	1 = Black	10,181	7.9
	0 = Not Black		
HISPANIC	1 = Hispanic	3,999	3.1
	0 = Not Hispanic		
WHITE*	1 = White	107,058	83.6
	0 = Not White		
OTHERACE	1 = Other Race	6,831	5.3
	0 = Not Other Race		
VETERAN	1 = Veteran	82,327	64.3
	0 = Not Veteran*	45,742	35.7
BA_BS86*	1 = Individual has a Bachelor's degree in 1986	95,598	74.6
	0 = Individual doesn't have a Bachelor's degree in 1986		
MA_MS86	1 = Individual has a Master's degree in 1986	28,374	22.2
	0 = Individual doesn't have a Master's degree in 1986		
PHD86	1 = Individual has a PhD degree in 1986	4,097	3.2
	0 = Individual doesn't have a PhD degree in 1986		
	1 =Rating level is 1	81	0.1
	2 =Rating level is 2	222	0.2
RATLEV	3 =Rating level is 3	48,195	37.6
	4 =Rating level is 4	50,109	39.1
	5 =Rating level is 5	29,462	23.0
SVISOR	1 = Individual has supervisory position	33,474	26.1
	0 = Individual doesn't have supervisory position*	94,595	73.9

Table 4.4. (cont.)

PROF	1 = Occupational category is Professional 0 = Occupational category is not Professional	68,081	53.2
ADMIN	1 = Occupational category is Administrative 0 = Occupational category is not Administrative	46,030	35.9
TECH*	1 = Occupational category is Technical 0 = Occupational category is not Technical	7,939	6.2
CLERK	1 = Occupational category is Clerical 0 = Occupational category is not Clerical	5,762	4.5
OTHERWC	1 = Occupational category is Other White Collar 0 = Occupational category is not Other White Collar	257	0.2
FLEET	1 = Functional area is Fleet 0 = Functional area is not Fleet	13,607	10.6
INTEL	1 = Functional area is Intelligence 0 = Functional area is not Intelligence	6,628	5.2
MATERIAL	1 = Functional area is Material 0 = Functional area is not Material	71,323	55.7
TRAINING	1 = Functional area is Training and Education 0 = Functional area is not Training and Education	7,553	5.9
MEDICAL	1 = Functional area is Medical 0 = Functional area is not Medical	2,833	2.2
HEADQRT	1 = Functional area is Department Headquarters 0 = Functional area is not Department Headquarters	2,659	2.1
ADMINACT*	1 = Functional area is Administrative Activities 0 = Functional area is not Administrative Activities	23,466	18.3
		N	**Mean**
FEDYEAR	Federal Service in years	128,069	11.5
GRADE86	Grade level in 1986	128,069	10.94

* Base case variable

3. Retention Model

From the perspective of an individual worker, the human capital model suggests that changing jobs is a costly transaction that will be undertaken voluntarily only if the net expected benefits are relatively large. Workers, then, are seen as using job mobility as a means of improving their personal well-being. From a more global perspective, however, worker mobility performs the socially useful role of matching workers with the employers who value their skills most highly. [Ref. 9]

Organizations want to retain qualified and experienced employees in their workforce. Retaining the most qualified employees is very important in increasing the productivity of the workforce and reducing manpower costs. Similarly, the organization must retain people for some period of time to be able to capture any training costs and realize a positive return on its training investments. Individuals will want to quit if their talents can command a higher wage (presumably because they are more productive) elsewhere; otherwise they will stay. The decision to stay or leave is primarily an individual decision, so it is important to take into account the individual characteristics that may explain retention.

We classify the factors that effect retention and job mobility into four categories: (1) wage effects; (2) cyclical effects; (3) age and job tenure effects; and (4) the costs of quitting. The effect of these factors can be summarized as follows:

- Human capital theory predicts that, other things being equal, a given worker will have a greater probability of quitting a low-wage job than a higher-paying one;

- Another implication of human capital theory is that workers will have a higher probability of quitting when it is relatively easy for them to obtain a better job quickly;

- The prediction that younger workers are more likely to make human capital investments of all kinds appears to be true for job mobility investments as well;

- Economic theory predicts that when the costs of quitting one's job are relatively low, mobility is more likely. [Ref. 9]

Many studies have been done about employee turnover and retention in the civilian sector. In 1987 Richard A. Ippolito conducted a study related specifically to quit rates in the federal government [Ref. 19]. Quit rates in the federal government were observed to be below those in the private sector. Some economists and the federal government itself had taken this to mean that federal wages were too high. His study provided an alternative explanation. It showed that the timing of compensation across a career as well as its level affects quit rates. The federal pension system, in particular, imposed large penalties on workers who quit early. And the portion of pay in the form of pensions was much higher for federal workers than for comparable non-federal workers. He concluded that this feature of the federal pay system explained the abnormally low quit rate among federal workers.

With the assumption that the DoD would retain civilian employees who perform better, we used retention as another performance measure. We built a logit model to see the effects of different explanatory variables on retention, measured as a binary outcome, whether a person decides either to stay or not. The basic model can be written as:

$$\textbf{\textit{Prob(Staying)}} = \beta_o + \beta X + \varepsilon$$

where

Prob(Staying) = probability of staying over a given period;

X = a vector of personal demographics and background characteristics that may influence the retention behavior;

β = a vector of parameters to be estimated;

β_o = a constant term; and

ε = an error term.

First, we took the entire inventory in September 1986 and then followed these individuals until September 1992. If an individual remained an employee of DoD between 1986 and 1992 the dependent variable RETENT92 takes the value of 1; if he/she did not, it takes the value of 0. Explanatory variables in the model include individual characteristics such as sex, race, age, and veteran status. Different functional areas may affect individual stay/leave decision because of different work environments and job satisfaction. For this reason dummy variables for "functional area" were captured in our retention model. A Federal service variable was also added to the model, but the model

was restricted to individuals with fewer than 15 years of federal service in 1986 because of the large effect on retention of individuals who were close to the retirement. For educational attainment, we included in the sample only those individuals without any change in education level between 1986 and 1992. Differing from the promotion model, we included "performance ratings" by calculating the average rating between 1986 and 1992. The model took into account the available number of ratings for every individual to calculate average rating. Obviously, those who left tended to receive fewer performance evaluations than those who stayed. We also excluded missing observations from the model. After these adjustments, there were a total of 112,953 observations in our model. Table 4.5 describes the dependent and independent variables in the model and provides descriptive statistics. We also ran the same model on the sample restricted to new hires in 1986 (See Table C.3 in Appendix C).

Table 4.5 Variable Definitions and Descriptive Statistics for Retention Model (N = 112,953)

Variable Name	Variable Description		
Dependent Variable		**N**	**%**
RETENT92	1 = Individual is still in DoD in 1992	88,936	78.7
	0 = Individual is not in DoD in 1992	24,017	21.3
Independent Variables			
FEMALE	1 = Female 0 = Male	34,342 78,611	30.4 69.6
BLACK	1 = Black 0 = Not Black	10,808	9.6
HISPANIC	1 = Hispanic 0 = Not Hispanic	3,584	3.2
WHITE*	1 = White 0 = Not White	91,392	80.9
OTHERACE	1 = Other Race 0 = Not Other Race	7,169	6.3
VETERAN	1 = Veteran 0 = Not Veteran	29,000 83,953	25.7 74.3
BA_BS86*	1 = Individual has a Bachelor's degree in 1986 0 = Individual doesn't have a Bachelor's degree in 1986	87,957	77.9
MA_MS86	1 = Individual has a Master's degree in 1986 0 = Individual doesn't have a Master's degree in 1986	21,437	19.0
PHD86	1 = Individual has a Ph.D. degree in 1986 0 = Individual doesn't have a Ph.D. degree in 1986	3,559	3.1
FLEET	1 = Functional area is Fleet 0 = Functional area is not Fleet	10,621	9.4
INTEL	1 = Functional area is Intelligence 0 = Functional area is not Intelligence	5,513	4.9
MATERIAL	1 = Functional area is Material 0 = Functional area is not Material	61,356	54.3
TRAINING	1 = Functional area is Training and Education 0 = Functional area is not Training and Education	7,313	6.5
MEDICAL	1 = Functional area is Medical 0 = Functional area is not Medical	4,168	3.7
HEADQRT	1 = Functional area is Department Headquarters 0 = Functional area is not Department Headquarters	2,661	2.4
ADMINACT*	1 = Functional area is Administrative Activities 0 = Functional area is not Administrative Activities	21,321	18.9
		N	**Mean**
FEDYEAR	Federal Service in years	112,953	6.07
AVERAGE	Average performance ratings between 1986 and 1992	112,953	3.96
AGE86	Age in 1986	112,953	36.05

* Base Case Variable

4. Performance Ratings Model

Performance ratings are regarded as soft and subjective measures of on-the-job productivity by many researchers since they are subject to several weaknesses. One potential weakness is that supervisors may be overly lenient in rating their subordinates; that is, some supervisors might be "harsh raters" and some others might be "easy raters." Harsh raters give evaluations that are lower than the "true" level of performance (if it can be ascertained); this is called *severity* or *negative leniency*, whereas easy raters give evaluations that are higher than the "true" level; this is called *positive leniency*. This problem usually occurs because the rater has applied personal standards derived from his/her own personality or previous experience [Ref. 20]. A second potential weakness of performance ratings is that an employee's personal characteristics (race, sex, age, and tenure) might influence supervisors' performance assessments. For example, the supervisor may have a generally favorable attitude toward an employee that will permeate all evaluations of this person. Typically, the supervisor has strong feelings about at least one important aspect of the employee's performance or characteristics. This is then generalized to other performance factors, and the employee is judged (across many factors) as uniformly good or bad. The third weakness of performance ratings, called central tendency error, refers to the supervisor's unwillingness to assign extreme-high or low-ratings. Everyone is "average," and only the middle (central) part of the rating scale is used [Ref. 20]. A final criticism of performance ratings might be that since different supervisors may have divergent beliefs about what constitutes good performance, ratings done by different supervisors should not be compared. While it does

seem unlikely that any two supervisors would be completely consistent in their evaluations, the results of laboratory studies suggest that a high degree of inter-rater reliability can be expected [Ref. 13].

Despite all the weaknesses and criticisms of performance ratings, one would still expect that, all the other relevant factors being the same, a company would be more likely to promote or give salary increases to those employees in a grade level whose current productivity, that is, current perceived relative performance, was the highest. And we can say that performance ratings were, or at least should have been, the legitimate indicators of this perceived relative performance between employees. Therefore, we decided to develop a performance model based on performance ratings of DoD civilian employees. We expect to have the same signs and comparable effects of the explanatory variables as in the salary and promotion models. If the results meet our expectations, they will provide evidence that performance ratings are significantly correlated with true relative productivity of civilian employees within the DoD.

For the performance ratings model, we took into account the federal employees serving in the DoD in FY1986 and created a dummy variable based on whether the average of their performance ratings between 1986 and 1994 fell into the top half of the distribution of all ratings. We computed the average performance ratings over an 8-year period (1986-1994) because the order of performance ratings was reverse for the last three years in the data file (1996, 1998, and 1999). Taking these three years into consideration would have required complex coding procedures. The dependent variable for this model, TOP, was derived by separating the observations whose average

performance ratings were above the mean value of all performance ratings (4.005). That is, if the individual's computed average performance rating exceeded the mean value of all employees in the sample; then, the dependent variable TOP took the value of 1; otherwise it took the value of 0. Because the dependent variable takes on a value of 0 or 1, meaning that an event either occurs or does not occur, the probit or logit models of binary outcomes are again more appropriate procedures than linear multiple regression procedures.

The basic performance-rating model can be written as:

$$\boldsymbol{Prob(Top)}=\beta_o+\beta X+\varepsilon$$

where;

Prob(Top)= probability of individual's average performance ratings' being greater than the mean value for the entire sample;

X= a vector of personal demographics and background characteristics that may have effect on performance ratings;

β= a vector of coefficients for the X factors;

β_o= a constant term; and

ε= an error term.

As the first step in shaping the data used in this model, we excluded employees with no valid performance ratings between 1986 and 1994. We included employees who had one or more valid performance ratings by 1994. All of the employees who left DoD

before 1994 had missing performance ratings. But, instead of excluding them, we computed the average of their available performance ratings and retained them in the sample. Next, we restricted the data to federal employees whose educational attainments remained unchanged between 1986 and 1994. That is, the individuals who attained a higher degree after 1986 were excluded because the average performance rating of such a person might have been affected by the change in education level. A final restriction was the exclusion of the individuals whose age in 1986 was not in the range of 22 to 65. In specifying the model, we included the same independent variables that were used in the salary and promotion models.

Among the explanatory variables, FEMALE is used to control for gender differentials in promotion. Racial and ethnic categories (Black, Hispanic, White, and "other") are added since different social backgrounds may affect actual on-the-job performance, or supervisors' perceptions of performance. Possible preferential treatment of veterans may also affect their performance ratings. We included educational attainment in three categories; Bachelor's degree, Master's degree, and Ph.D. Education level is expected to be a determinant of a successful career path, and improve an individual's adaptability or ability to cope with job demands. Supervisory status was included due to the possibility that once an individual becomes a supervisor, his/her performance ratings would not be as likely to reflect his/her true performance as they are before and might be inflated because of his seniority. The same argument may apply to an employee's federal experience as well. As federal experience goes up, so does seniority. Therefore, "number of years in federal service" was added to model. We also

controlled for prior experience, which may reflect general work force experience and be a factor in increasing one's performance ratings. And, finally, since the evaluation criteria for performance ratings and measurement of success differ across occupational groups as well as across functional areas, we included dummies for the five main occupational groups (professional, administrative, technical, clerical, and other white collar) and seven major functional areas (fleet, intelligence and communication, material, training and education, medical, department headquarters, and administrative activities).

Table 4.6 describes the variables included in the model, and provides descriptive statistics. As seen in the table, there are 78,303 individuals out of 187,049 observations who ranked in the top category of average performance ratings, which accounts for 41.9 percent of all observations. Bachelor's degree holders comprise 75 percent of the sample while Master's degree and Ph.D. holders account for 21.8 and 3.2 percent, respectively. The mean of employees' years of federal service is 12.2 years. The mean performance rating, which was used in defining top category of performance ratings, is 4.0. Table C.4 gives descriptive statistics for the "new hires" sample.

Table 4.6. Variable Definitions and Descriptive Statistics for Performance Ratings Model (N=187,049)

Variable Name	Variable Description	N	%
Dependent Variable		**N**	**%**
TOP	1 =Individual's average performance rating is greater than sample mean for all employees*	78,303	41.9
	0 = Individual's average performance rating is smaller than sample mean for all employees*	108,746	58.1
Independent Variables			
FEMALE	1 = Female	43,581	23.3
	0 = Male**	143,468	76.7
BLACK	1 = Black	15,219	8.1
	0 = Not Black		
HISPANIC	1 = Hispanic	5,768	3.1
	0 = Not Hispanic		
WHITE**	1 = White	156,001	83.4
	0 = Not White		
OTHERACE	1 = Other Race	10,061	5.4
	0 = Not Other Race		
VETERAN	1 = Veteran	116,465	62.3
	0 = Not Veteran**	70,584	37.7
BA_BS86**	1 = Individual has a Bachelor's degree in 1986	140,305	75.0
	0 = Individual doesn't have a Bachelor's degree in 1986		
MA_MS86	1 = Individual has a Master's degree in 1986	40,782	21.8
	0 = Individual doesn't have a Master's degree in 1986		
PHD86	1 = Individual has a Ph.D. degree in 1986	5,962	3.2
	0 = Individual doesn't have a Ph.D. degree in 1986		
SVISOR	1 = Individual has supervisory position	48,712	26.0
	0 = Individual doesn't have supervisory position*	138,337	74.0
PROF	1 = Occupational category is Professional	98,612	52.7
	0 = Occupational category is not Professional		
ADMIN	1 = Occupational category is Administrative	65,554	35.0
	0 = Occupational category is not Administrative		
TECH**	1 = Occupational category is Technical	12,535	6.7
	0 = Occupational category is not Technical		
CLERK	1 = Occupational category is Clerical	10,036	5.4
	0 = Occupational category is not Clerical		

Table 4.6. (cont.)

OTHERWC	1 = Occupational category is Other White Collar 0 = Occupational category is not Other White Collar	432	0.2
FLEET	1 = Functional area is Fleet 0 = Functional area is not Fleet	21,679	11.6
INTEL	1 = Functional area is Intelligence 0 = Functional area is not Intelligence	9,088	4.9
MATERIAL	1 = Functional area is Material 0 = Functional area is not Material	101,310	54.2
TRAINING	1 = Functional area is Training and Education 0 = Functional area is not Training and Education	10,971	5.9
MEDICAL	1 = Functional area is Medical 0 = Functional area is not Medical	5,186	2.8
HEADQRT	1 = Functional area is Department Headquarters 0 = Functional area is not Department Headquarters	4,639	2.5
ADMINACT**	1 = Functional area is Administrative Activities 0 = Functional area is not Administrative Activities	34,796	18.6
		N	**Mean**
FEDYEAR	Federal Service in years	187,049	12.1
AVERAGE	Average performance rating	187,049	4.0

*Mean value of average performance ratings for all employees (4.0).
**Base case variable.

V. MULTIVARIATE ANALYSIS AND RESULTS

This chapter presents the results of the multivariate analysis of the four different performance models (salary, promotion, retention, and performance ratings) that were described above in Chapter IV. Each model is discussed separately in terms of its overall significance, the significance of its explanatory variables, the partial effects for the variables in the logit models, and goodness-of-fit measures.

A. RESULTS OF SALARY MODEL

Ordinary least squares (OLS) techniques were used to estimate the salary model that was specified in the following form;

$$\mathit{ln(Y)} = \beta_0 + \beta X + \varepsilon$$

as explained in detail in Chapter IV. Before presenting the results we think it is useful to give some information about the interpretation of the coefficients (parameter estimates). In this kind of model, the slope coefficients measure the constant proportional or relative change in Y for a given absolute change in the value of X (independent variables), that is,

β = ***Relative change in regressand / Absolute change in regressor***

This means that if we multiply the relative change in Y by 100, it gives the percentage change, or the growth rate, of Y for an absolute change in X, the regressor [Ref. 21]. This explanation about the interpretation of parameter estimates will be useful in understanding the results of this model in the following sections. The full regression

results are presented in Table 5.1. Recall from Chapter IV that for the salary model, we ran a two step model, the first without grade controls, and the second step including grade level as a control variable. Table 5.1 gives the results of both steps.

1. Goodness of Fit

In a linear regression model, the coefficient of determination (R^2) is a summary measure that tells us how well the sample regression line fits the data. It is the most commonly used measure of the goodness-of-fit of a regression model. Simply put, R^2 measures the proportion of the total variation in Y explained by the variation in the explanatory variables. [Ref. 21] Table 5.1 presents the results from estimating the salary model. In the first step of our salary model, R^2 is equal to 0.7653, which means 76.53 percent of the variation in the log of annual salary is explained by the variation in the explanatory variables included in the model. In the second step, R^2 is equal to 0.9539.

Other measures of goodness-of-fit are overall significance of the model and the significance of individual coefficients. For our model we have an F value of 25,963 and a Prob>F value of 0.0001, which means we reject the null hypothesis that all the coefficients in the model are equal to zero. In other words, the model has some explanatory power. All the independent variables, except OTHERACE, are statistically significant at 0.01 level. We decide this by looking at Prob > T values in the SAS output. As long as the significance level is greater than Prob > T value, we reject the null hypothesis that an individual coefficient is equal to zero.

2. Model Results

Almost all of the explanatory variables in Table 5.1 have the expected signs, that is, they have the expected positive or negative impacts on the dependent variable. The coefficients of MA_MS86, PHD86, METROP86, FEDYEAR, PRIEXP, and SVISOR are all positive as expected. The coefficients of FEMALE, BLACK, HISPANIC, VETERAN, CLERK, and OTHERWC are all negative as expected. These results are consistent with past studies. While we would have expected OTHERACE to be negative, it is positive, but not significant. This may be because this category comprises only 5.2 percent of the sample.

Other interesting findings from the model are that women earn 10.72 percent less than men, everything else held constant. There are also differences in minority salaries as Blacks earn 6.41 percent less than Whites, while Hispanics earn 1.94 percent less. A person with one more year of federal service experience earns 3.73 percent more. On the other hand, the effect of prior experience is nearly zero; an individual with one more year of prior labor market experience earns only a 0.1 percent higher annual federal salary. Individuals in "professional" and "administrative" jobs have higher annual salaries while individuals in "clerical" and "other white collar" jobs have lower annual salaries than individuals in "technical" jobs. Individuals in supervisor positions have 18.48 percent higher annual salaries. A person who works in the South Atlantic census region earns 6.03 percent higher annual salary than a worker in the Pacific census region (Column 1 in Table 5.1).

Both of the education variables have positive effects on salary and they are significant at the 0.01 level. Master's degree holders earn 4.99 percent more than Bachelor's degree holders. This positive effect on annual salary is much higher for Ph.D. holders at 16.26 percent. These findings are consistent with the basic assumption of human capital theory that individuals with higher educational attainment earn more. However, one should be careful about the interpretation of coefficients. If we consider that Master's degree and Ph.D. degree holders begin their jobs in higher grade levels and there is a very high correlation between grade levels and annual salary (0.9017), then the effects of educational attainment may be overstated in the model. Tables 5.2 and 5.3 display the distribution of educational attainment by occupational category and grade level, respectively. Table 5.2 shows that M.A. holders are more likely to be classified in the "professional" occupational classification. Also, the modal entry grade for M.A. holders is GS-9, whereas for B.A.'s it is GS-7. To be able to see the effect of educational attainment more accurately we controlled for grade levels in the second step by introducing GRADE86 variable into the model in Column 3 of Table 5.1. Controlling for grade level gives us within-grade earnings differentials.

In the second model, all the variables except SFEDYEAR and OTHERWC are significant at the 0.01 level. Having an M.A. again has a positive effect on annual salary but its magnitude is very close to zero (0.003). Master's degree holders earn only a 0.3 percent higher annual salary when grade level is controlled. Thus, controlling for current grade level reduces the impact of M.A. by 94 percent. In this model Ph.D. degree holders earn 4.04 percent higher annual salary compared to Bachelor's degree holders.

Controlling for grade level reduces the impact of a doctorate by 75 percent. In other words, most of the effect of the educational attainment variables is associated with differences in grade levels. Column 3 of Table 5.1 reveals that the effect of almost all of the variables in the model fall after GRADE86 is introduced. The effect of SVISOR, for example, decreases from 18.48 percent to only 3.96 percent.

Table 5.1. Parameter Estimates and Standard Errors of Semi-log Salary Model for all Federal Workers, 1986

Independent Variables	Without Grade Control		With Grade Control	
	Parameter Estimate	Standard Error	Parameter Estimate	Standard Error
INTERCEPT	9.7217*	0.0024	9.0572*	0.0013
FEMALE	-0.1073*	0.0011	-0.0389*	0.0005
BLACK	-0.0641*	0.0015	-0.0158*	0.0007
HISPANIC	-0.0194*	0.0025	-0.0078*	0.0011
OTHERACE	0.0012	0.0019	0.0099*	0.0008
VETERAN	-0.0543*	0.0010	-0.0285*	0.0005
MA_MS86	0.0499*	0.0010	0.0030*	0.0005
PHD86	0.1627*	0.0024	0.0404*	0.0011
METROP	0.0158*	0.0011	-0.0015*	0.0005
FEDYEAR	0.0373*	0.0002	0.0084*	0.0001
SFEDYEAR	-0.0006*	0.0000	0.0000	0.0000
PRIEXP	0.0009*	0.0002	0.0011*	0.0001
SQPRIEXP	-0.0001*	0.0000	0.0000*	0.0000
NEWENG	0.0369*	0.0022	0.0045*	0.0010
MIDATLAN	0.0260*	0.0016	0.0029*	0.0007
EASTNC	0.0524*	0.0016	0.0039*	0.0007
WESTNC	-0.0144*	0.0021	-0.0185*	0.0009
SOUTHAT	0.0604*	0.0013	0.0117*	0.0006
EASTSC	0.0164*	0.0019	-0.0032*	0.0008
WESTSC	-0.0422*	0.0018	-0.0112*	0.0008
MOUNTAIN	-0.0072*	0.0021	-0.0050*	0.0009
SVISOR	0.1849*	0.0010	0.0396*	0.0005
PROF	0.3638*	0.0017	0.0576*	0.0008
ADMIN	0.2294*	0.0017	-0.0066*	0.0008
CLERK	-0.2350*	0.0024	0.0331*	0.0011
ORHERWC	-0.2806*	0.0081	0.0040	0.0036
GRADE86	N.I.**	N.I.	0.1083	0.0001
R^2	0.7653		0.9539	
F VALUE	25,953		158,467	
SAMPLE SIZE	119,070		119,070	

*Significant at 0.01 level.
**N.I. = not included

Table 5.2. Percentage Distribution of Educational Attainment by Occupational Category

OCCUPATIONAL CATEGORY	1986 INVENTORY			NEW HIRES		
	B.A./B.S.	M.A./M.S.	Ph.D	B.A./B.S.	M.A./M.S.	Ph.D
Professional	50.47	58.33	87.57	55.62	57.53	88.66
Administrative	35.21	36.39	11.21	21.47	27.53	10.82
Technical	7.58	3.35	0.63	8.02	7.22	0.00
Clerical	6.44	1.81	0.53	14.06	7.01	0.52
Other White Collar	0.30	0.12	0.07	0.84	0.72	0.00
TOTAL*	100	100	100	100	100	100

*Individual percentages may not add up to 100 because of rounding.

Table 5.3. Percentage Distribution of Educational Attainment by Grade Levels

GRADE LEVELS	1986 INVENTORY			NEW HIRES		
	B.A./B.S.	M.A./M.S.	Ph.D	B.A./B.S.	M.A./M.S.	Ph.D
1	0.01	0.00	0.00	0.08	0.00	0.00
2	0.05	0.02	0.00	0.43	0.00	0.00
3	1.03	0.29	0.02	5.88	2.16	0.00
4	2.35	0.80	0.15	6.51	4.54	0.00
5	6.28	1.59	0.36	29.84	8.35	1.03
6	1.41	0.38	0.18	0.73	0.52	0.00
7	9.01	3.22	0.59	33.11	17.53	2.58
8	0.48	0.21	0.00	0.44	0.93	0.00
9	12.62	9.73	3.03	11.93	33.30	10.31
10	0.46	0.39	0.08	0.25	0.52	0.00
11	19.15	17.01	7.70	6.62	17.63	22.68
12	25.95	27.60	25.14	3.17	10.31	43.81
13	13.55	20.55	23.89	0.55	2.37	10.82
14	5.56	12.14	22.98	0.35	1.03	6.70
15	2.07	6.06	15.77	0.13	0.82	2.06
16	0.02	0.01	0.08			
17	0.00	0.00	0.00			
18	0.00	0.00	0.02			
TOTAL*	100	100	100	100	100	100

*Individual percentages may not add up to 100 because of rounding.

We also ran the same model for a sample of new hires only. Table 5.4 displays estimates from this model. All the variables except HISPANIC, OTHERACE,

METROP86, MIDATLAN, WESTSC, and MOUNTAIN are significant at the 0.01 level. OTHERACE is significant at the 0.05 level. For this model R^2 is 0.5775, and Prob > F value is 0.0001, which that means we reject the null hypothesis that all the parameter estimates are equal to zero.

All the variables except HISPANIC, VETERAN, and MOUNTAIN have the same signs as in the inventory model. Veterans have an advantage at the beginning of their employment. They earn 5.99 percent higher annual salaries compared to non-veterans, all other things held constant.

Educational attainment variables again have positive signs. And their effects are greater than they were in the cross-sectional model of all workers in Table 5.1. Master's degree holders earn 8.98 percent higher annual entry level salaries while Ph.D.'s earn 28.22 percent more. For the full sample in Table 5.1 these effects were 4.99 percent and 16.27 percent for M.A.'s and Ph.D.'s, respectively.

These results are consistent with the findings of Dunson (1985). He also found that M.A. and Ph.D. degree holders generally earned more than those with a B.A. degree because they were in grades with higher mean earnings. He stated that only 26 percent of the total earnings differentials between those with doctorates and those with B.A. degrees occurred within-grade in the Army sample. For the same sample, only 20 percent of the earnings differential occurred within-grade when M.A.'s were compared to B.A.'s.

Table 5.4 Parameter Estimates and Standard Errors of Semi-log 1986 Starting Salary Model for New Hires

Independent Variables	Parameter Estimate	Standard Error
INTERCEPT	9.5839*	0.0126
FEMALE	-0.0750*	0.0054
BLACK	-0.0399*	0.0082
HISPANIC	0.0076	0.0130
OTHERACE	0.0213**	0.0086
VETERAN	0.0599*	0.0107
MA_MS86	0.0898*	0.0074
PHD86	0.2823*	0.0155
METROP	0.0033	0.0065
PRIEXP	0.0139*	0.0009
SQPRIEXP	-0.0002*	0.0000
NEWENG	0.0654*	0.0135
MIDATLAN	0.0113	0.0096
EASTNC	0.0469*	0.0098
WESTNC	-0.0420*	0.0131
SOUTHAT	0.0712*	0.0071
EASTSC	0.0395*	0.0128
WESTSC	-0.0090	0.0087
MOUNTAIN	0.0051	0.0123
SVISOR	0.3242*	0.0148
PROF	0.3378*	0.0094
ADMIN	0.1014*	0.0100
CLERK	-0.2101*	0.0111
ORHERWC	-0.1751*	0.0281
R^2	0.5775	
F VALUE	443.971	
SAMPLE SIZE	7,495	

*Significant at 0.01 level.
**Significant at 0.05 level.

B. RESULTS OF PROMOTION MODEL

In the construction of the promotion model in Chapter 4, we included only federal employees serving in the DoD in 1986 and looked at their promotion histories between 1986 and 1992. The purpose of choosing a 6-year period was to allow greater variation in the promotion outcomes over time and to keep the number of observations high for better statistical reliability. A binary dependent variable PROMOTE for this model was created based on individuals who were promoted at least once between September 1986 and September 1992. The data set identified "date of last promotion" for each federal employee, which is the data element used to construct the dependent variable. If the individual's date of last promotion as of 1992 data set fell between 1986 and 1992, the dependent variable PROMOTE took a value of 1, otherwise it took the value of 0.

Four specifications of the basic promotion model are examined in this section. In the first specification, we run the model without controls for grade level and performance rating. In the second specification, we introduce grade level controls. Following that, only controls for the individual's performance rating are added to the model. In the final specification, we run the model including the controls for both grade level and performance rating.

For the promotion model, maximum likelihood logit techniques were used to estimate the probability of being promoted for a particular individual based on the following equation;

$$\textit{Prob(Promote)} = \beta_0 + \beta X + \varepsilon$$

The interpretation of coefficients from logit models is not as straightforward as in OLS model. The basic logit equation can be written as:

$$L_i = ln\ (P_i/1-P_i) = \beta_0 + \beta X + \varepsilon$$

where L is "logit," and $(P_i\ /\ 1-P_i)$ is the odds ratio in favor of being promoted. The interpretation of β, the slope, is the change in L for a unit change in X; that is, it tells how the log-odds in favor of being promoted change as, let's say, years of federal service changes by one year. The constant (intercept) β_0 is the value of log-odds in favor of being promoted if years of federal service is zero. Like most interpretations of intercepts, this interpretation may not have any useful meaning. [Ref. 21] Finally, the probability of being promoted is calculated using the following equation, which is derived from the logit equation above and known as *cumulative logistic distribution function:*

$$P_i = 1/1 + e^{-(\beta_0 + \beta X)}$$

In the following sections, the measures of goodness-of-fit and the results of the promotion model will be discussed.

1. Goodness of Fit

Before interpreting the results, the "goodness of fit" of the model is examined. There are three measures of goodness-of-fit in a logit model: 1) The likelihood value and its p-value; 2) The statistical significance of each of the explanatory variables in the model; and 3) The classification table. The first determinant of goodness of fit in a logit model is the –2 LOG L value. This value is distributed Chi-square, and tests the

hypothesis that all coefficients are no different from zero. The –2 Log L value for the promotion model is 157,710 (p=.0001). Thus, at least one of the coefficients is significantly different from zero. In other words, the model has some explanatory power.

In the inventory model, for the first stage, we have 16 of the 19 variables are significant at the 0.01 level or better. When we introduced controls for both grade level and individual's performance 15 out of 21 explanatory variables were statistically significant.

As the third measure of a model's fit, we would like to maximize the number of correctly predicted events and non-events in the model. The term "event" in the promotion model can be defined as an observation that is predicted to be promoted when the person actually gets promoted. And, similarly, a "non-event" is an observation that is predicted as not being promoted who does not actually get promoted. The classification tables of the promotion models provide us with almost 65-70 percent correctly predicted events and non-events at cut-off points of 0.5 and 0.56. Since we have high percentages of correctly predicted events and non-events along with the significant Chi-square value and the high number of statistically significant variables we conclude that the goodness-of-fit of the promotion models is acceptable.

2. Model Results

In the first specification of the promotion model, we did not control for grade level in order to focus on the effects of individual characteristics on promotion probability. Table 5.5 provides a list of the explanatory variables along with parameter

estimates, standard errors, and partial effects for the models with and without grade controls. The results in column 1 of Table 5.5 shows that all the independent variables except HISPANIC, CLERK, and FLEET are statistically significant at the 0.01 level. However, five of the independent variables -- BLACK, HISPANIC, VETERAN, MA_MS86, and PHD86 -- have different signs from what were expected. We expected that Blacks, and Hispanics would be less likely to be promoted than Whites, and veterans would be less likely to be promoted than non-veterans. Furthermore, we assumed that higher educational attainment should lead to higher probability of promotion. The MA_MS86 and PHD86 variables have negative signs, which means that Master's degree and Ph.D. holders are less likely to get promoted than Bachelor's degree holders. Except for these five, all the other variables have expected signs as hypothesized in Chapter IV. The FEMALE variable has a positive sign while OTHERACE, FEDYEAR, and SVISOR have negative signs.

In the promotion model, the notional person is specified as a white male, non-veteran, non-supervisor, with a Bachelor's degree, who has 11.5 years of federal service and occupies a technical job in an administrative area. An individual with the characteristics of the notional person has a predicted promotion probability of .664. The partial (marginal) effects displayed in Table 5.5 are computed based on this notional person by changing each variable one unit one at a time. All the other things constant, women are 6.35 percentage points more likely to be promoted, Blacks are 2.2 percentage points more likely to be promoted, and those from other racial categories (except Hispanics) are 7.11 percentage points less likely to be promoted. Veterans appear to be

1.01 percentage points more likely to be promoted than non-veterans. Supervisors are 7.8 percentage points less likely to be promoted compared to non-supervisors. FEDYEAR is estimated as negatively correlated with promotion probability. One additional year of federal service decreases the promotion probability by 1.91 percentage points.

Table 5.5. Logit Estimates, Standard Errors and Partial Effects of Promotion Model[a]
(without control for individual's performance rating level)

Independent Variables	(1) Without Grade Control			(2) With Grade Control		
	Parameter Estimate	Standard Error	Partial Effects	Parameter Estimate	Standard Error	Partial Effects
INTERCEPT	1.6549	0.0320		4.3005	0.0515	
FEMALE	0.3009*	0.0174	0.0635	0.1072*	0.0181	0.0268
BLACK	0.1003*	0.0238	0.0220	-0.0429	0.0246	-0.0107
HISPANIC	0.0366	0.0352	0.0081	-0.0836**	0.0361	-0.0208
OTHERACE	-0.3055*	0.0270	-0.0711	-0.3881*	0.0278	-0.0943
VETERAN	0.0458*	0.0140	0.0101	0.0853*	0.0143	0.0213
MA_MS86	-0.0732*	0.0148	-0.0165	0.0825*	0.0151	0.0206
PHD86	-0.2549*	0.0346	-0.0590	0.1293*	0.0350	0.0323
FEDYEAR	-0.0844*	0.0009	-0.0191	-0.0560*	0.0010	-0.0139
SVISOR	-0.2599*	0.0149	-0.0602	0.1966*	0.0162	0.0491
PROF	-0.3340*	0.0271	-0.0780	0.5577*	0.0313	0.1377
ADMIN	-0.2233*	0.0272	-0.0514	0.4959*	0.0306	0.1229
CLERK	0.0207	0.0407	0.0046	-0.9936*	0.0447	-0.2225
OTHERWC	1.0533*	0.1668	0.1857	0.0552	0.1723	0.0138
FLEET	-0.2579*	0.0240	-0.0597	-0.2992*	0.0247	-0.0733
INTEL	-0.0310	0.0304	-0.0069	0.0730**	0.0311	0.0182
MATERIAL	-0.2173*	0.0165	-0.0500	-0.1194*	0.0170	-0.0296
TRAINING	-0.4752*	0.0289	-0.1126	-0.5915*	0.0296	-0.1406
MEDICAL	-0.7447*	0.0427	-0.1798	-0.9337*	0.0440	-0.2112
HEADQRT	-0.3756*	0.0447	-0.0881	-0.0734	0.0459	-0.0182
GRADE86				-0.3457*	0.0048	-0.0843
- 2 LOG L	157,710			151,843		
SAMPLE SIZE	128,069			128,069		

*Significant at 0.01 level.
**Significant at 0.05 level.
[a]Dependent variable = PROMOTE: (0) Not promoted by 1992, (1) Promoted by 1992.

Having a Master's degree or Doctorate is negatively correlated with promotion. Master's degree holders have a 1.65 percentage point lower promotion probability, and Ph.D. holders have a 5.95 percentage point lower promotion probability. These results may not be surprising if we recall that Master's degree and Ph.D. holders occupy higher grade levels and promotion opportunities tend to be less numerous at the higher grades. Thus, Master's degree or Ph.D. holders may have lower chances of being promoted than Bachelor's degree holders who are hired at lower grade levels. Therefore, we introduced a control for the grade level in 1986 into the model in order to investigate within-grade effects of the right hand side variables on the promotion probability.

In the promotion model with a control for the grade in 1986, there are only three independent variables out of 20 that are not significant: BLACK, OTHERWC, and HEADQRT. HISPANIC and INTEL are statistically significant at the 0.05 level, while all other 15 independent variables are significant at the 0.01 level or better. Differing from the model without grade control, all explanatory variables have expected signs in accordance with the hypotheses in Chapter IV. All minority variables have negative signs. That is, Blacks, Hispanics, and other minority groups are 1.07, 2.08, and 9.43 percentage points, respectively, less likely to be promoted than Whites. The effect of educational attainment seems to favor promotion when we control for the grade in 1986. Both a Master's degree and a Ph.D. have a significant and positive effect on promotion. A Master's degree holder is estimated to have 2.06 percentage points higher promotion probability, and an individual with Ph.D. is 3.23 percentage points more likely to be promoted.

For the third and fourth specifications of the promotion model, we re-estimated the previous two models (with/without grade control) but included controls for each individual's performance ratings during the 1986-1992 period. If supervisor ratings reflect true on-the-job performance they should be a key element distinguishing between those who do and those who do not get promoted. Thus, an individual's in-house perceived job performance should be controlled in the model. Table 5.6 displays the results for the models that include control for an employee's performance rating level. Introducing RATLEV causes either small increases or decreases in the partial effects of the other explanatory variables when we do not control for grade level. All the variables have the same signs as they do in the first specification of the promotion model. The signs of MA_MS86 and PHD86 are negative again. The results suggest that a Master's degree holder is 1.86 percentage points less likely to be promoted, and a Ph.D. holder is 6.44 percentage point less likely to be promoted when we do not control for grade level.

In the final specification, we control for both performance rating level and grade level. Introducing both controls decreases the partial (marginal) effects in general. The signs of all the variables except that of BLACK remain unchanged from the second specification of promotion model in Table 5.5. BLACK is not found to be statistically significant along with HISPANIC, OTHERWC, and INTEL. All the remaining variables are significant at the 0.01 level. MA_MS86 and PHD86 have positive and slightly smaller partial effects than they do in the second specification in Table 5.5. The results suggest that an Master's degree increases promotion probability by 1.92 percentage points, which is 0.14 percentage point smaller than the effect in the specification in Table

5.5 when we do not control for performance rating level. Likewise, a Ph.D. increases promotion by 2.9 percentage points, which is 0.33 percentage point less than the effect in the specification controlling for 1986 grade level but not controlling for performance rating level in Table 5.5.

Table 5.6. Logit Estimates, Standard Errors and Partial Effects of Promotion Model[a]
(with control for individual's performance rating level)

Independent Variables	(3) Without Grade Control			(4) With Grade Control		
	Parameter Estimate	Standard Error	Partial Effects	Parameter Estimate	Standard Error	Partial Effects
INTERCEPT	1.0021	0.0426		3.4914	0.0569	
FEMALE	0.2943*	0.0174	0.0612	0.0865*	0.0182	0.0216
BLACK	0.1343*	0.0239	0.0288	0.0002	0.0247	0.0001
HISPANIC	0.0587	0.0353	0.0128	-0.0591	0.0363	-0.0147
OTHERACE	-0.3010*	0.0271	-0.0693	-0.3870*	0.0279	-0.0942
VETERAN	0.0359**	0.0141	0.0079	0.0724*	0.0144	0.0181
MA_MS86	-0.0834*	0.0148	-0.0186	0.0770*	0.0152	0.0192
PHD86	-0.2806*	0.0348	-0.0644	0.1160*	0.0352	0.0290
RATLEV	0.1859*	0.0081	0.0395	0.2743*	0.0084	0.0685
FEDYEAR	-0.0865*	0.0009	-0.0193	-0.0572*	0.0009	-0.0142
SVISOR	-0.2834*	0.0149	-0.0651	0.1893*	0.0163	0.0473
PROF	-0.3354*	0.0272	-0.0776	0.6079*	0.0315	0.1495
ADMIN	-0.2273*	0.0273	-0.0518	0.5305*	0.0308	0.1311
CLERK	0.0202	0.0408	0.0044	-1.0523*	0.0450	-0.2338
OTHERWC	1.0550*	0.1665	0.1822	-0.0049	0.1719	-0.0012
FLEET	-0.3099*	0.0242	-0.0714	-0.3757*	0.0249	-0.0915
INTEL	-0.0714**	0.0306	-0.0159	0.0207	0.0313	0.0051
MATERIAL	-0.2353*	0.0165	-0.0537	-0.1374*	0.0171	-0.0341
TRAINING	-0.5248*	0.0290	-0.1299	-0.6696*	0.0299	-0.1579
MEDICAL	-0.8151*	0.0428	-0.1963	-1.0487*	0.0444	-0.2332
HEADQRT	-0.4481*	0.0449	-0.1050	-0.1596*	0.0463	-0.0395
GRADE86				-0.3662*	0.0049	-0.0893
- 2 LOG L	157,176			150,749		
SAMPLE SIZE	128,069			128,069		

*Significant at 0.01 level.
**Significant at 0.05 level.
[a]Dependent variable = PROMOTE: (0) Not promoted by 1992, (1) Promoted by 1992.

In general, the effect of educational level on promotion probability is found to be statistically significant in all four specifications shown in Tables 5.5 and 5.6. The variables for educational attainment get negative signs when we do not control for each individual's grade level in 1986. This result seems reasonable when we think that higher degree holders occupy positions at higher grade levels and usually these positions have less chance of later promotion due to there being fewer openings at higher grades. When we control for grade level to see the within-grade effects of educational level on promotion the signs of the education are positive as we expected. Introducing control for performance rating level in the later stages makes no change in the signs but lowers the partial effects slightly.

C. RESULTS OF RETENTION MODEL

In Chapter IV, we described the retention model based on stay-leave decisions for the 6-year period between 1986 and 1992. An individual either remains a federal worker during this period or he/she leaves. Because of the binary nature of the dependent variable the logit technique was used. If an individual is still a federal worker in 1992, the independent variable RETENT92 takes the value of 1, otherwise it takes the value of 0. The parameter estimate in the logit model measures the change in L [ln(Prob(stay)/1-Prob(stay))] for a unit change in a given independent variable. That is, a slope coefficient (parameter estimate) in this retention model tells how the log-odds in favor of staying change as the independent variable changes by a unit. In the following sections, we will explain goodness-of-fit measures for the model and estimates of this model for both the

full 1986 cross-sectional sample and the new hires sample. The logit model estimates for both the inventory sample and for new hires in 1986 are presented in Table 5.7.

1. Goodness of Fit

A general goodness-of-fit measure for logit model is the -2 LOG LIKELIHOOD statistic. This statistic has a chi-square distribution under the null hypothesis that all regression coefficients in the model are zero. The -2 LOG L values for the inventory and "new hires" samples are 107,689 and 6243, respectively. We test this hypothesis by looking at the p-value. For both samples we have p-values of 0.0001, which means as long as the significance level is greater than this value, we reject the null. When the null hypothesis is rejected, it can be concluded that the regression model has some explanatory power.

As a second goodness-of-fit measure, we can look at the significance of the individual variables. We decide whether a variable is significant by looking at the Pr>Chi-Square value. If the significance level is greater than this value then the variable is statistically significant. For the 1986 inventory, 15 out of 16 explanatory variables are significant at the 0.01 level. For "new hires" sample 10 out of 15 explanatory variables are significant at the 0.01 level.

Another measure of goodness-of-fit is the classification table. The ability of a retention model to classify stayers and leavers accurately provides some indication as to the usefulness of the model. "Sensitivity" is the ratio of the number of stayers correctly predicted as stayers, while "specificity" is the ratio of the number of leavers correctly

predicted as leavers by the model. We want these two to be as high as possible. Actual retention rate (stayers/total sample) for the 1986 inventory is 0.79 (88936/112953). This gives us an idea about the cutoff point. Predicted probabilities below this point are classified as leavers and those above it are classified as stayers. At this point our model correctly predicts 60.7 percent of the stayers, and 65.3 percent of the leavers.

2. Model Results

All the independent variables in the first column of Table 5.7 except HISPANIC are significant at the 0.01 level. The independent variables FEMALE, VETERAN, AGE86, MA_MS86, PHD86, FLEET, TRAINING, MEDICAL, and HEADQRT all have negative signs. The effect of age on retention is not consistent with the assumption that older workers have less job mobility than younger workers. Note, however, the definition of separation used here includes people who leave the DoD, but remain in federal service in a non-DoD agency. Although we excluded individuals with a federal service greater than 14 years to avoid the negative effect of retirement on retention, some individuals in our 1986 inventory sample might still gain their retirement eligibility during this period. Negative signs of educational attainment variables can be explained by higher job opportunities in the labor market. The variables BLACK, HISPANIC, OTHERACE, FEDYEAR, AVERAGE, INTEL, and MATERIAL all have positive signs. The positive signs of ethnicity and race variables can be explained by lower job opportunities in the labor market. Firm-specific experience, FEDYEAR, is also consistent with past studies. As one's years of federal service increases, it means an individual is accumulating larger

amounts of firm-specific human capital. Average performance rating during this period, AVERAGE, also has a positive effect on retention, which means better performers have a higher probability of staying in DoD. This is consistent with our expectation.

To comment on the relative effects of individual variables we have to calculate partial (marginal) effects. For this model, a person with base case characteristics (male, white, non-veteran, 36.05 years of age, B.A. holder, with an average performance rating of 3.96, with federal experience of 6.07 years, and working in a "technical" area) has a predicted retention probability of 0.7997. The model calculates probabilities by increasing each variable by one unit. The difference between base case probability and calculated probability for a variable's one unit change gives us the partial effect of that variable.

The retention model indicates that women are 9.12 percentage points less likely to stay when compared to men; Blacks and Hispanics are 3.18 and 0.72 percentage points, respectively, more likely to stay in DoD. Each additional year of age reduces the retention rate by 0.16 percentage points. A person with one more federal service year is 0.81 percentage points more likely to stay. A person with a 1-unit higher average performance rating (e.g. going from 4 to 5) during the period between 1986 and 1992 is 10.29 percentage points more likely to stay in DoD. MEDICAL has the greatest effect on retention among functional area; an individual in "medical" area is 16.73 percentage points less likely to stay in DoD when compared to a person in "technical" area.

Both educational attainment variables are significant at the 0.01 level. M.A.'s are 1.58 percentage points less likely to stay and Ph.D.'s are 2.61 percentage points less

likely to stay. These negative effects may arise because of job opportunities for more educated workers in the labor market.

Table 5.7. Logit Estimates, Standard Errors and Partial Effects of Retention Model[a]

Independent Variables	1986 Inventory			1986 New Hires		
	Parameter Estimate	Standard Error	Partial Effect	Parameter Estimate	Standard Error	Partial Effect
INTERCEPT	-1.8911*	0.0593		-4.3695*	0.2505	
FEMALE	-0.4964*	0.0174	-0.0912	-0.3848*	0.0677	-0.0725
BLACK	0.2119*	0.0259	0.0318	0.3114*	0.1037	0.0484
HISPANIC	0.0456	0.0424	0.0072	-0.1246	0.1576	-0.0220
OTHERACE	0.3913*	0.0335	0.0555	0.5995*	0.1124	0.0852
VETERAN	-0.1265*	0.0212	-0.0210	0.0254	0.1403	0.0043
AGE86	-0.0103*	0.0009	-0.0016	0.0170*	0.0044	0.0029
MA_MS86	-0.0961*	0.0198	-0.0158	-0.2744*	0.0954	-0.0503
PHD86	-0.1555*	0.0451	-0.0261	-0.3142	0.2039	-0.0582
FEDYEAR	0.0513*	0.0020	0.0081			
AVERAGE	0.8422*	0.0128	0.1029	1.3822*	0.0591	0.1525
FLEET	-0.2391*	0.0285	-0.0410	-0.8994*	0.1274	-0.1886
INTEL	0.1972*	0.0383	0.0297	0.0512	0.1437	0.0086
MATERIAL	0.5073*	0.0197	0.0692	0.1829**	0.0764	0.0296
TRAINING	-0.1217*	0.0330	-0.0202	-0.9641*	0.1498	-0.2043
MEDICAL	-0.8420*	0.0379	-0.1673	-1.6098*	0.1391	-0.3643
HEADQRT	-0.1774*	0.0495	-0.0299	-0.6801*	0.1798	-0.1369
-2 LOG L	107,689			6,243		
SAMPLE SIZE	112,953			6,007		

*Significant at 0.01 level.
**Significant at 0.05 level.
[a]Dependent variable = RETENT92: (0) Individual is not in DoD in 1992, (1) Individual is still in DoD in 1992.

For the new hires model, in Columns 4-6 of Table 5.7, all the variables except HISPANIC, VETERAN, PHD86, INTEL, and MATERIAL are significant at the 0.01 level. In the new hires sample veterans and older workers have higher retention rates. This sample has a younger population than the inventory sample and retirement might have little effect on the retention decision. This is consistent with the literature that older

people are less likely to change jobs and job mobility is greater for younger workers. Positive effect of salary in early years of employment of veterans may affect their "stay" decision.

Again performance rating has a positive effect on retention. A person with a one-unit higher average performance rating is 15.25 more likely to stay. We can conclude that in early years of employment performance ratings have a greater effect on the stay/leave decision.

For this sample, PHD86 variable is not statistically significant, while MA_MS86 is significant at the 0.01 level. Both educational attainment variables have negative signs as in the 1986 inventory sample. An M.A. holder who is a new hire is 5.03 percentage points less likely to stay in DoD. This prediction is greater than that in the inventory sample where the effect was 1.58 percentage points. This is also consistent with the expectation and literature on this area that in early years of employment people are more likely to change jobs. During this time the job matching and job search processes induce job changes.

D. RESULTS OF PERFORMANCE RATINGS MODEL

In the performance ratings model developed in Chapter IV, we included in the sample all federal employees serving in the DoD in FY1986 and created a dummy variable based on whether the average of their performance ratings between 1986 and 1994 fell into the top half of the distribution for all ratings. We computed the average

performance ratings over an 8-year period (1986-1994). The dependent variable for this model, TOP, is based on an individual having an average performance rating which exceeds the mean value of all performance ratings (4.005) over the 1986-1994. That is, if the individual's computed average performance rating exceeded the mean value of all employees in the sample, then the dependent variable TOP took the value of 1; otherwise it took the value of 0. The basic performance-ratings model can be written as:

$$\boldsymbol{Prob(Top)}=\beta_o+\beta X+\varepsilon$$

Because the dependent variable is dichotomous, meaning that an event either occurs or does not occur, the logit technique was again used for estimations. The theoretical background of the logit model was explained in detail earlier in the thesis. Recall that the coefficients of the independent variables measure the change in L (logit) for a unit change in each explanatory variable. That is, a coefficient in this performance ratings model tells how the log-odds of being in the top half of the distribution of all ratings changes as one of the explanatory variables changes by one unit. In the following sections, the goodness-of-fit and the models both for 1986 inventory and 1986 new hires will be discussed as well as the parameter estimates. The results for both the inventory sample and for new hires in 1986 are displayed in table 5.8.

1. Goodness of Fit

The three measures of goodness-of-fit for logit models indicate acceptable model performance for the performance-ratings models for both the 1986 inventory sample and the 1986 new hires sample. The log-likelihood values for the inventory and "new hires"

samples are 245,741 and 8,687, respectively. The p-values for both samples are 0.0001, which means that at least one of the coefficients in the model is significantly different from zero. In other words, the performance-ratings model has some explanatory power.

In the inventory model, 18 of 19 variables are significant at the 0.01 level. For the "new hires" model, the number of significant variables is 13 out of 18; six are significant at the 0.01 level, two are significant at the 0.05 level, and five at the 0.10 level.

The classification tables for the two models provide us with almost 60 percent correctly predicted events and non-events at cut-off points of 0.4 and 0.48. The term "event" in the performance-ratings model is defined as an observation predicted to be in the top half of performance ratings when the person is actually in the top half. And, similarly, the term "non-event" is an observation that is predicted to be in the bottom half when she/he is actually in the bottom half. Since we have high percentages of correctly predicted events and non-events we conclude that we have an acceptable goodness-of-fit for both models.

2. Model Results

In the 1986 inventory sample all the independent variables except CLERK are significant at the 0.01 level. All the variables have the signs hypothesized in Chapter IV. The explanatory variables BLACK, HISPANIC, OTHERACE, FEDYEAR, and OTHERWC are negatively correlated with being in the top half of the distribution of all performance ratings. The rest of the variables -- FEMALE, VETERAN, MA_MS86, PHD86, SVISOR and occupational group and functional area -- have positive signs.

In the performance-ratings model, the notional person is specified as a male, white, non-veteran, non-supervisor, with a bachelor's degree, who has 12.2 years of federal service, and whose occupational group is technical and functional area is administrative. An individual with the characteristics of the notional person has a predicted probability of .267 to be in the top half category of the performance ratings distribution. The partial (marginal) effects displayed in Table 5.8 are computed based on this notional person by changing each variable one unit one at a time.

Other things constant, the model estimates that women are 1.06 percentage point more likely to be in the top half of the performance ratings distribution. Blacks, Hispanics, and those categorized as other race have 8.3, 4.53, and 3.71 percentage points lower probabilities of being in the TOP half category. A veteran is 4.75 percentage points more likely to be rated in the TOP category. A supervisor, compared to a non-supervisor, is 11.57 percentage points more likely to have an average of performance ratings that fall in the top half of the distribution. This huge differential may be perceived as evidence that the performance ratings of the individuals who have supervisory status are inflated. Holding everything else constant, one more year of federal service increases the probability of being in the top half by 0.21 percentage point. Of all occupational group variables, "administrative" has the largest positive marginal effect of 6.42 percentage points on the dependent variable (when compared to the technical occupational group). Furthermore, a person who works in any headquarters is 18.03 percentage point more likely to fall in top half of performance rating distribution than a person who works in any administrative functional area.

Both of the education variables, MA_MS86 and PHD86, are significant at the 0.01 level. Master's degree holders are 3.6 percentage points more likely to have average performance ratings in the top half, and Ph.D. holders are 6.27 percentage points more likely to be in the top half. These results show that, as hypothesized in Chapter IV, educational attainment indicates an individual's adaptability or ability to cope with job demands and an important determinant of career success.

In the "new hires" sample, FEDYEAR variable is excluded since all the observations are at the beginning of their federal career. For the "new hires" model, only 9 out of 18 explanatory variables are significant. BLACK, SVISOR, ADMIN, INTEL, MATERIAL, and HEADQRT are significant at the 0.01 level. The MA_MS86 variable is insignificant while PHD variable is significant at the 0.05 level. All the explanatory variables have expected signs except FEMALE. Also the VETERAN variable has the opposite sign as in the inventory model. The veterans' advantage in initial placement may put them into jobs for which they are not fully qualified, thus their average performance ratings are likely to be lower than those of non-veterans in the early stages of their careers.

As shown in Table 5.8, the estimates suggest that, among newly hired employees, women are 2.14 percentage points less likely to be in the top half of all performance ratings. Likewise, veterans are 4.41 percentage points less likely to be in the TOP category. For this model, MA_MS86 variable is not statistically significant, and PHD86 is significant at the 0.05 level. Both of the education variables have positive signs as in the 1986 inventory model. A new hire with an M.A. is 3.42 percentage points more likely

to be in top half of all performance ratings distribution, while a Ph.D. holder is 8.58 percentage points more likely to be in the top half.

Table 5.8. Logit Estimates, Standard Errors and Partial Effects of Performance-Ratings Model[a]

Independent Variables	1986 Inventory			1986 New Hires		
	Parameter Estimate	Standard Error	Partial Effects	Parameter Estimate	Standard Error	Partial Effects
INTERCEPT	-0.8771	0.0247		-0.2638	0.1378	
FEMALE	0.0536*	0.0113	0.0106	-0.0878	0.0587	-0.0214
BLACK	-0.4791*	0.0188	-0.0830	-0.3248*	0.0859	-0.0775
HISPANIC	-0.2458*	0.0284	-0.0453	-0.2573	0.1329	-0.0618
OTHERACE	-0.1988*	0.0217	-0.0371	-0.2997*	0.0870	-0.0717
VETERAN	0.2303*	0.0116	0.0475	-0.1819	0.1031	-0.0441
MA_MS86	0.1765*	0.0118	0.0360	0.1383	0.0763	0.0342
PHD86	0.3002*	0.0275	0.0627	0.3450**	0.1597	0.0858
SVISOR	0.5316*	0.0121	0.1157	0.6145*	0.1515	0.1524
FEDYEAR	-0.0108*	0.0006	-0.0021			
PROF	0.0779*	0.0208	0.0155	0.1187	0.0974	0.0294
ADMIN	0.3069*	0.0209	0.0642	0.3765*	0.1049	0.0937
CLERK	0.0313	0.0285	0.0062	0.2095	0.1141	0.0520
OTHERWC	-0.2813*	0.1059	-0.0514	0.0067	0.3301	0.0017
FLEET	0.5954*	0.0184	0.1309	-0.0265	0.0941	-0.0065
INTEL	0.3720*	0.0242	0.0790	0.5692*	0.1184	0.1413
MATERIAL	0.0848*	0.0132	0.0169	0.3986*	0.0646	0.0992
TRAINING	0.9296*	0.0230	0.2131	0.3230**	0.1325	0.0804
MEDICAL	0.8943*	0.0309	0.2043	0.0664	0.1223	0.0164
HEADQRT	0.7977*	0.0326	0.1803	0.7256*	0.162	0.1790
-2 LOG L	245,741			8,687		
SAMPLE SIZE	187,049			6,404		

*Significant at 0.01 level.
**Significant at 0.05 level.
[a]Dependent variable = TOP: (0) Individual's average performance rating is smaller than sample mean for all employees, (1) Individual's average performance rating is greater than sample mean for all employees.

VI. CONCLUSIONS AND RECOMMENDATIONS

A. SUMMARY

In this thesis, we examined the effects of graduate education on the job performance of civilian employees in the Department of Defense (DoD). The research required us to review the nature of the federal civilian personnel systems especially the areas of pay, promotion, and performance appraisal. Federal employees are subject to periodic appraisals of their performance under Performance Management Regulations issued by the office of Personnel Management (OPM). The appraisal systems are based on objective, job-related criteria and have performance standards for each element of the job on which an employee is to be evaluated. The DoD civilian employee appraisal system has five levels of performance rating with level 1 as the lowest and level 5 as the highest.

The DoD promotion system is based on merit. Competition among employees is generally required. To be eligible for promotion employees generally must meet the position's qualifications, and, if applicable, time-in-grade requirements, the time-âfter-competitive-appointment restriction, and requirements for "fully successful" performance.

There are various pay systems used by the federal government that are also applicable to the DoD civilian workforce. Most of the DoD civilian employees are paid under one of the two main government pay systems: (1) the "general schedule" (GS) pay

system, which sets specific salary levels for the white-collar civilian workers; or (2) the wage system, which pertains the DoD's craft and trade (blue-collar) workers. Both GS and wage system (WS) rates are established and adjusted annually pursuant to law and implementing regulations. In addition, there are a number of other pay schedules and salary systems that govern the amount of compensation paid to certain unique groups of government employees.

The effects of post-secondary education on an individual's career have been studied extensively. In particular, a few researchers have investigated the return on investment for pursuing graduate education. For example, David A.Wise (1975) conducted two studies in 1975 and concluded that graduate education provided a positive increase on salary for the employees of a single firm. Studies that have observed this effect have attributed the higher earnings to increased job performance. On the other hand, James Medoff and Katharine Abraham (1980) found a positive association between experience and relative earnings within grade levels in three U.S. manufacturing corporations. However, they found no association, or a negative association, between experience and rated performance (a proxy for productivity). They suggest that these findings provide evidence contrary to the implications of human capital theories that the higher earnings of more experienced workers in a firm reflect their on-the-job training, which makes them more productive than their less experienced peers. Similarly, B. Dunson (1985) replicated one of the Medoff-Abraham tests to examine whether differences in earnings for a selected group of civilian middle managers and professionals in the DoD can be explained by the hypothesis that more experienced workers are more

productive workers. His results were similar to those of Medoff and Abraham. Finally, Mehay and Bowman (1999) examined the effect of graduate education on the job performance of Navy officers. They used promotion as a performance measure and found that those with graduate degrees were more likely to be promoted. The effect was somewhat larger for those with degrees funded by the Navy. However, the effects of graduate degrees were smaller in models that adjusted for selection bias.

The primary research question for this thesis was: "What is the effect of graduate education on the job performance of DoD civilian employees? That is, what is the payoff to employees and the DoD, from advanced education?" For the study, we adopted the approach of human capital theory that an individual's productivity, and on-the-job performance, increases with additional education. To be able to answer this question different proxy measures for on-the-job performance -- salary level, promotion probability, performance ratings, and retention -- were analyzed extensively in this thesis using multivariate data analysis techniques.

The data used in this thesis were drawn from Department of Defense Civilian Personnel Data Files, which were provided by Defense Manpower Data Center (DMDC). Two data files exist for DoD civilian personnel: (1) an inventory (current status) file, and (2) a transaction (dynamic) file. Both file types contain similar data elements. For the purpose of this study, DMDC merged these two files into the one on which we based the four job-performance models.

Ordinary least square (OLS) methods were used to estimate salary models and maximum likelihood logit techniques were used to estimate the binary promotion,

retention, and performance-ratings models. Salary, retention, and performance-ratings models were run for two separate samples:(1) 1986 inventory that includes only the employees who were serving in DoD in 1986, and (2) 1986 new hires that comprise only the employees who were hired in 1986. Each of the salary and promotion models was run twice; first with no controls for grade level, then with controls. Almost all the models resulted in a substantial number of statistically significant variables and a high level of goodness-of-fit. Other than a few exceptions, most of the explanatory variables had expected signs. Along with educational attainment, sex, race, veteran status, and experience (years of federal service and/or prior experience) were estimated to have substantial effects on the-job-performance. Table 6.1 summarizes the effects of having a Master's degree on different performance measures.

Table 6.1. The Effect of Master's Degree on Different Performance Measures*

Models	Specifications	1986 Inventory	New Hires
Salary**	1	4.99	8.99
	2	0.30	N.A.
Promotion***	1	-1.65	N.A.
	2	2.06	N.A.
	3	-1.86	N.A.
	4	1.92	N.A.
Retention	N.A.	-1.58	-5.03
Performance Rating	N.A.	3.60	3.42

*Percentage effect on annual salary; Marginal effect (in percentage points) on the probability of promotion, retention, or being in "Top" performance category.
**(1) without controlling for grade; (2) controlling for grade
***(1)without controlling for grade; (2) controlling for grade; (3) controlling "performance rating" without grade control; and (4) controlling for both "performance rating" and grade.
N.A. = Not applicable

B. CONCLUSIONS

The effect of having a Master's degree on annual salary level was positive and statistically significant. This positive effect was much smaller when "grade level" was introduced into the model in the second stage. This result is not surprising if we consider that Master's degree holders enter the organization in positions at higher grade levels and the basic determinant of annual salary is grade level. When we ran the model for the "new hires" sample, we found that the effect of a Master's degree was higher at the beginning of employment in the DoD. Although the grade control lowered the effect, it was still significant. This positive effect of a Master's degree is consistent with past studies and with human capital investment theory.

When promotion probability was considered as a performance measure, the effect of graduate education was found to be statistically significant in all four specifications of the model. The control variable for Master's degree had a negative sign when we did not control for grade level. This result seems reasonable when we consider that individuals with higher educational attainment occupy positions at higher grade levels and people in these positions usually have fewer opportunities for promotion due to fewer openings at those levels in the hierarchical structure of the organization. When we controlled for grade level to see the within-grade effect of a Master's degree on promotion, the effect was positive as expected. Introducing controls for performance rating level in the later stages made no change in the direction of the effect but lowered the marginal effect of a Master's degree slightly.

The effect of graduate education on retention (the probability of staying) was negative and statistically significant. This negative effect was much higher when we ran the model for the "new hires" only sample. Both findings from this model are reasonable because of greater job opportunities in the labor market for Master's degree holders compared to Bachelor's degree holders. Individuals invest in graduate education expecting higher returns in the future. So, they are more likely to search for better opportunities in the labor market especially in the early years of their employment.

The last productivity measure was performance rating level. The effect of a Master's degree was found to be positive and statistically significant. This positive effect was almost the same in both the inventory and "new hires" samples. This finding confirms our assumption that individuals with higher educational attainment, in our case Master's degree holders, are better performers compared to Bachelor's degree holders.

In summary, we conclude that Master's degree holders earn higher annual salaries and are more likely to promote. They are more productive workers within the DoD. On the other hand, they are less likely to stay in the DoD when compared to Bachelor's degree holders. All these findings are consistent with basic human capital investment theory. But they contradict with the findings of Dunson (1985) and Medoff and Abraham (1980) that there is no relation between human capital investment and on-the-job performance.

C. RECOMMENDATIONS FOR FURTHER RESEARCH

This thesis investigated the effects of graduate education on the job performance of DoD civilian employees. We found that graduate education has a positive effect on annual salary, promotion, and performance rating; a negative effect on retention.

Until this thesis, no known attempt has been made to investigate the effect of graduate education on the job performance of federal civilian employees using the performance measures we have developed. Because this is the first research in this area, further research is strongly recommended. Specific points for further research are discussed in the following paragraphs.

First of all, the Department of Defense Civilian Personnel Data File that we used for this study has some problems. Performance ratings and promotion information for some DoD agencies was not provided for some years. Also, there were some flaws in the "educational attainment" and "year of degree attained" data elements. These problems continued even after we received a revised data file from DMDC. We tried to fix these problems before we ran our multivariate models. We recommend these problems be corrected by the DMDC to help future researchers to obtain more accurate results.

Secondly, we did not investigate whether there was a difference of the effect of graduate education among different DoD agencies. We recommend that the sample be separated by agency to see if the effect of graduate education differs across agencies.

As a third recommendation, we encourage future Manpower System Analysis (MSA) Curriculum students to focus on specific functional or occupational areas. Our

study investigated a general sample without restriction to a specific occupational category or a specific functional area. We recommend focusing on a specific performance measure like promotion, as Mehay and Bowman (1999) did, to give more concrete results about a specific functional/occupational area. Also, we developed four performance measures for our research: salary level, promotion, performance rating, and retention. Developing different performance measures, such as time elapsed between two consecutive promotions or salary differentials between two selected years, will give more insight into the effect of a Master's degree on the job performance.

As a last recommendation, we want to mention the possibility of selection bias. In our research we could not find any information about a fully funded graduate education program for civilian employees. For this reason, we did not have to analyze selection bias. However, if possible, information should be collected on when M.A. degrees were completed by employees and on whether the employer or the employee paid for the degree.

APPENDIX A. DEFENSE CIVILIAN PERSONNEL DATA FILE RECORD LAYOUT (AS OF JANUARY 1998)
(Source: Defense Manpower Data Center)

FIELD	FIELD NAME	TYPE	LENGTH	START	END	FIELD	FIELD NAME	TYPE	LENGTH	START	END
1	SSN	B	4	1	4	55	Rating of Record (Period) -- YYYYMM	C	6	101	106
2	Service Computation Date (Leave) - YYYYMM	B	3	5	7	56	Bargaining Unit	B	2	107	108
3	U.S. Citizenship	B	1	8	8	57	Annuitant Indicator	B	1	109	109
4	Date of Birth-YYYYMM	B	3	9	11	58	FLSA Category	B	1	110	110
5	Work Schedule	B	1	12	12	59	Legal Authority - One(Transaction File Only)	C	3	111	113
6	Personnel Office ID (formerly SON)	B	2	13	14	60	Legal Authority - Two (Transaction File Only)	C	3	114	116
7	Reserved	C	8	15	22	61	Veterans Status (Active Military Service)	B	1	117	117
8	Occupation	C	5	23	27	62	Defense Support Activity	B	1	118	118
9	Functional Classification	B	1	28	28	63	Seasonal Flag	B	1	119	119
10	Reserved	C	5	29	33	64	OPM Region	B	1	120	120
11	Time in Hours	B	1	34	34	65	Census Region	B	1	121	121
12	Handicap	B	1	35	35	66	Census District	B	1	122	122
13	Pay Rate Determinant	B	1	36	36	67	Filler	C	4	123	126
14	Pay Basis	B	1	37	37	68	Current Appointment Authority One	C	3	127	129
15	Veterans Preference (Appointment)	B	1	38	38	69	Filler	C	2	130	131
16	Tenure	B	1	39	39	70	Health Plan	C	3	132	134
17	Fed. Employees Grp. Life Ins - FEGLI	B	1	40	40	71	Creditable Military Service (Leave)	B	2	135	136
18	Retirement Plan	B	1	41	41	72	Date of Last Promotion -- YYYYMM	B	3	137	139
19	Position Occupied	B	1	42	42	73	Date Entered Current Grade -- YYYYMM	B	3	140	142
20	DoD Transfer Indicator	B	1	43	43	74	Position Sensitivity	B	1	143	143
21	Sex	B	1	44	44	75	Filler	C	2	144	145
22	Agency	B	1	45	45	76	Frozen Service	B	2	146	147
23	Bureau	B	1	46	46	77	Previous Retirement Coverage	B	1	148	148
24	Pay Plan	B	1	47	47	78	Language Identification -- First Language	C	2	149	150
25	Grade, Level Class, Rank or Pay Band	B	1	48	48	79	Language Listening Proficiency --First Language	B	1	151	151
26	Step or Rate	B	1	49	49	80	Language Reading Proficiency -- First Language	B	1	152	152
27	Nature of Action Code	C	3	50	52	81	Language Speaking Proficiency -- First Language	B	1	153	153
28	Supervisory	B	1	53	53	82	Filler	C	2	154	155
29	Education Level	B	1	54	54	83	Language Identification--Second Language	C	2	156	157
30	Year Degree or Certif. Attained -- YYYY	B	2	55	56	84	Language Listening Proficiency-- Second Language	B	1	158	158
31	Reserved	C	1	57	57	85	Language Reading Proficiency--Second Language	B	1	159	159
32	Race or National Origin	B	1	58	58	86	Language Speaking Proficiency-- Second Language	B	1	160	160
33	Unit Identification Code -- UIC	C	6	59	64	87	Filler	C	2	161	162
34	Program Element Code	C	6	65	70	88	FERS Coverage	B	1	163	163
35	Civil Function Indicator	B	1	71	71	89	Army Service Career Program	B	1	164	164
36	Military Technician Flag	B	1	72	72	90	Filler	C	1	165	165
37	Appropriation RIC	C	4	73	76	91	Employee Name	C	23	166	188
38	Active Strength Flag	B	1	77	77	92	Basic Pay Rate (not necessarily annualized)	C	6	189	194
39	Total Federal Service Months	B	2	78	79	93	Basic Pay (annualized)	C	6	195	200
40	Total Federal Service Years	B	1	80	80	94	Award Amount (Transaction File Only)	C	5	201	205
41	Age	B	1	81	81	95	Consolidated Metropolitan Statistical Area	B	1	206	206
42	Mog-Fog	B	1	82	82	96	Locality Adjustment Area	C	2	207	208
43	Functional Area	B	1	83	83	97	Filler	C	5	209	213
44	Reserved	C	5	84	88	98	Staffing Differential	C	5	214	218
45	PATCO	C	1	89	89	99	Filler	C	43	219	261
46	Metropolitan Statistical Area	B	2	90	91	100	Instructional Program	C	6	262	267
47	Wage Area	B	1	92	92	101	Effective Date of Personnel Action -YYYYMMDD	B	4	268	271
48	Emergency-Essential Agreement Flag	B	1	93	93	102	Veterans Preference (RIF)	C	1	272	272
49	Retirement Eligibility	B	1	94	94	103	Country	C	2	273	274
50	DoD Occupation Group	B	2	95	96	104	State	C	2	275	276
51	Filler	C	1	97	97	105	City	C	4	277	280
52	Reserve Category	C	1	98	98	106	County	C	3	281	283
53	Rating of Record (Pattern)	C	1	99	99	107	CinC Code	C	1	284	284
54	Rating of Record (Level)	C	1	100	100	108	Reserved	C	91	285	375

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX B. DEFENSE CIVILIAN PERSONNEL DATA FILE LAYOUT (8609 THROUGH 9902)

(DATA ELEMENTS USED IN THE THESIS)

(Source: Defense Manpower Data Center)

FIELD	FIELD NAME	TYPE	LENGTH	START	END	FIELD	FIELD NAME	TYPE	LENGTH	START	END
1	SERVICE COMPUTATION DATE (YYMM)	N	4	1	4	52	EDUCATION	N	2	128	129
2	CITIZEN	N	1	5	5	53	YEAR DEGREE ATTAINED	N	2	130	131
3	DATE OF BIRTH (YYMM)	N	4	6	9	54	RACE	N	1	132	132
4	NATURE OF ACTION DATE (YYMM)	N	4	10	13	55	TOTAL FEDERAL SERVICE MONTHS	N	3	133	135
5	SALARY	C	5	14	18	56	TOTAL FEDERAL SERVICE YEARS	N	2	136	137
6	OCCUPATION	C	5	19	23	57	AGE	N	2	138	139
7	STATE/COUNTRY	N	3	24	26	58	YEARLY COMPENSATION	C	5	140	144
8	CITY	N	4	27	30	59	METROPOLITAN STATISTICAL AREA (MSA)	N	4	145	148
9	COUNTY	N	3	31	33	60	WAGE AREA	N	3	149	151
10	VETERANS PREFERENCE	N	1	34	34	61	DOD OCCUPATION GROUP	N	4	152	155
11	TENURE	N	1	35	35	62	SEASONAL FLAG	N	1	156	156
12	SEX	N	1	36	36	63	CENSUS REGION	N	2	157	158
13	AGENCY	N	1	37	37	64	CENSUS DISTRICT	N	2	159	160
14	BUREAU	N	2	38	39	65	CREDITABLE MILITARY SERVICE (YYMM)	N	4	161	164
15	PAYPLAN	N	2	40	41	66	DATE OF LAST PROMOTION (YYMM)	N	4	165	168
16	GRADE	N	2	42	43	67	DATE ENTERED CURRENT GRADE (YYMM)	N	4	169	172
17	STEP	N	2	44	45	68	RATING	N	1	173	173
18	EDUCATION	N	2	46	47	69	SUPERVISORY	N	1	174	174
19	YEAR DEGREE ATTAINED (YY)	N	2	48	49	70	PATCO	N	1	175	175
20	RACE	N	1	50	50	71	FUNCTIONAL AREA	N	1	176	176
21	TOTAL FEDERAL SERVICE MONTHS	N	3	51	53	72	SERVICE COMPUTATION DATE (YYMM)	N	4	177	180
22	TOTAL FEDERAL SERVICE YEARS	N	2	54	55	73	CITIZEN	N	1	181	181
23	AGE	N	2	56	57	74	DATE OF BIRTH (YYMM)	N	4	182	185
24	YEARLY COMPENSATION	C	5	58	62	75	NATURE OF ACTION CODE (YYMM)	N	4	186	189
25	METROPOLITAN STATISTICAL AREA	N	4	63	66	76	OCCUPATION	C	5	190	194
26	WAGE AREA	N	3	67	69	77	STATE/COUNTRY	N	3	195	197
27	DOD OCCUPATION GROUP	N	4	70	73	78	CITY	N	4	198	201
28	SEASONAL FLAG	N	1	74	74	79	COUNTY	N	3	202	204
29	CENSUS REGION	N	2	75	76	80	VETERANS PREFERENCE	N	1	205	205
30	CENSUS DISTRICT	N	2	77	78	81	TENURE	N	1	206	206
31	RATING	N	1	79	79	82	SEX	N	1	207	207
32	SUPERVISORY	N	1	80	80	83	AGENCY	N	1	208	208
33	PATCO	N	1	81	81	84	BUREAU	N	2	209	210
34	FUNCTIONAL AREA	N	1	82	82	85	PAYPLAN	N	2	211	212
35	SERVICE COMPUTATION DATE (YYMM)	N	4	83	86	86	GRADE	N	2	213	214
36	CITIZEN	N	1	87	87	87	STEP	N	2	215	216
37	DATE OF BIRTH (YYMM)	N	4	88	91	88	EDUCATION	N	2	217	218
38	NATURE OF ACTION DATE (YYMM)	N	4	92	95	89	YEAR DEGREE ATTAINED	N	2	219	220
39	SALARY	C	5	96	100	90	RACE	N	1	221	221
40	OCCUPATION	C	5	101	105	91	TOTAL FEDERAL SERVICE MONTHS	N	3	222	224
41	STATE/COUNTRY	N	3	106	108	92	TOTAL FEDERAL SERVICE YEARS	N	2	225	226
42	CITY	N	4	109	112	93	AGE	N	2	227	228
43	COUNTY	N	3	113	115	94	YEARLY COMPENSATION	C	6	229	234
44	VETERANS PREFERENCE	N	1	116	116	95	METROPOLITAN STATISTICAL AREA (MSA)	N	4	235	238
45	TENURE	N	1	117	117	96	WAGE AREA	N	3	239	241
46	SEX	N	1	118	118	97	DOD OCCUPATION GROUP	N	4	242	245
47	AGENCY	N	1	119	119	98	SEASONAL FLAG	N	1	246	246
48	BUREAU	N	2	120	121	99	CENSUS REGION	N	2	247	248
49	PAYPLAN	N	2	122	123	100	CENSUS DISTRICT	N	1	249	249
50	GRADE	N	2	124	125	101	CREDITABLE MILITARY SERVICE (YYMM)	N	4	250	253
51	STEP	N	2	126	127	102	DATE OF LAST PROMOTION (YYMM)	N	4	254	257

FIELD	FIELD NAME	TYPE	LENGTH	START	END
103	DATE OF CURRENT GRADE (YYMM)	N	4	258	261
104	SALARY	C	6	262	267
105	RATING	N	1	268	268
106	SUPERVISORY	N	1	269	269
107	PATCO	N	1	270	270
108	FUNCTIONAL AREA	N	1	271	271
109	SERVICE COMPUTATION DATE (YYMM)	N	4	272	275
110	CITIZEN	N	1	276	276
111	DATE OF BIRTH (YYMM)	N	4	277	280
112	NATURE OF ACTION DATE (YYMM)	N	4	281	284
113	OCCUPATION	C	5	285	289
114	STATE/COUNTRY	N	3	290	292
115	CITY	N	4	293	296
116	COUNTY	N	3	297	299
117	VETERANS PREFERENCE	N	1	300	300
118	TENURE	N	1	301	301
119	SEX	N	1	302	302
120	AGENCY	N	1	303	303
121	BUREAU	N	2	304	305
122	PAYPLAN	N	2	306	307
123	GRADE	N	2	308	309
124	STEP	N	2	310	311
125	EDUCATION	N	2	312	313
126	YEAR DEGREE ATTAINED	N	2	314	315
127	RACE	N	1	316	316
128	TOTAL FEDERAL SERVICE MONTHS	N	3	317	319
129	TOTAL FEDERAL SERVICE YEARS	N	2	320	321
130	AGE	N	2	322	323
131	YEARLY COMPENSATION	C	6	324	329
132	METROPOLITAN STATISTICAL AREA	N	4	330	333
133	WAGEAREA	N	3	334	336
134	DOD OCCUPATION GROUP	N	4	337	340
135	SEASONAL FLAG	N	1	341	341
136	CENSUS REGION	N	2	342	343
137	CENSUS DISTRICT	N	1	344	344
138	CREDITABLE MILITARY SERVICE (YYMM)	N	4	345	348
139	DATE OF LAST PROMOTION (YYMM)	N	4	349	352
140	DATE OF CURRENT GRADE (YYMM)	N	4	353	356
141	SALARY	C	6	357	362
142	RATING	N	1	363	363
143	SUPERVISORY	N	1	364	364
144	PATCO	N	1	365	365
145	FUNCTIONAL AREA	N	1	366	366
146	SERVICE COMPUTATION DATE (YYMM)	N	4	367	370
147	CITIZEN	N	1	371	371
148	DATE OF BIRTH (YYMM)	N	4	372	375
149	NATURE OF ACTION DATE (YYMM)	N	4	376	379
291	DATE OF LAST PROMOTION (YYMM)	N	4	741	744
292	DATE ENTERED GRADE (YYMM)	N	4	745	748
293	PAYRATE	C	6	749	754
294	BASIC PAY	C	6	755	760
295	RATING	C	1	761	761
296	SUPERVISORY	N	1	762	762
297	PATCO	C	1	763	763
298	FUNCTIONAL AREA	N	1	764	764
299	CONSOLIDATED MSA	N	2	765	766
300	INSTRUCTIONAL PROGRAM	C	6	767	772
301	NATURE OF ACTION DATE (YYMM)	N	4	773	776
302	COUNTRY	C	2	777	778

FIELD	FIELD NAME	TYPE	LENGTH	START	END
150	OCCUPATION	C	5	380	384
151	STATE/COUNTRY	N	3	385	387
152	CITY	N	4	388	391
153	COUNTY	N	3	392	394
154	VETERANS PREFERENCE	N	1	395	395
155	TENURE	N	1	396	396
156	SEX	N	1	397	397
157	AGENCY	N	1	398	398
158	BUREAU	N	2	399	400
159	PAYPLAN	N	2	401	402
160	GRADE	N	2	403	404
161	STEP	N	2	405	406
162	EDUCATION	N	2	407	408
163	YEAR DEGREE ATTAINED	N	2	409	410
164	RACE	N	1	411	411
165	TOTAL FEDERAL SERVICE MONTHS	N	3	412	414
166	TOTAL FEDERAL SERVICE YEARS	N	2	415	416
167	AGE	N	2	417	418
168	YEARLY COMPENSATION	C	6	419	424
169	METROPOLITAN STATISTICAL AREA (MSA)	N	4	425	428
170	WAGEAREA	N	3	429	431
171	DOD OCCUPATION GROUP	N	4	432	435
172	SEASONAL FLAG	N	1	436	436
173	CENSUS REGION	N	2	437	438
174	CENSUS DISTRICT	N	1	439	439
175	CREDITABLE MILITARY SERVICE (YYMM)	N	4	440	443
176	DATE OF LAST PROMOTION (YYMM)	N	4	444	447
177	DATE ENTERED GRADE (YYMM)	N	4	448	451
178	SALARY	C	6	452	457
179	RATING	N	1	458	458
180	SUPERVISORY	N	1	459	459
181	PATCO	N	1	460	460
182	FUNCTIONAL AREA	N	1	461	461
183	CONSOLIDATED MSA	N	2	462	463
184	INSTRUCTIONAL PROGRAM	N	6	464	469
185	SERVICE COMPUTATION DATE (YYMM)	N	4	470	473
186	CITIZEN	N	1	474	474
187	DATE OF BIRTH (YYMM)	N	4	475	478
188	NATURE OF ACTION DATE (YYMM)	N	4	479	482
189	OCCUPATION	C	5	483	487
190	STATE/COUNTRY	N	3	488	490
191	CITY	N	4	491	494
192	COUNTY	N	3	495	497
193	VETERANS PREFERENCE	N	1	498	498
194	TENURE	N	1	499	499
195	SEX	N	1	500	500
196	AGENCY	N	1	501	501
303	STATE	C	2	779	780
304	CITY	C	4	781	784
305	COUNTY	C	3	785	787
306	RATING PATTERN	C	1	788	788
307	RATING PERIOD	C	6	789	794
308	FLAG88	N	1	795	795
309	FLAG90	N	1	796	796
310	FLAG92	N	1	797	797
311	FLAG94	N	1	798	798
312	FLAG96	N	1	799	799
313	FLAG98	N	1	800	800
314	FLAG99	N	1	801	801

FIELD	FIELD NAME	TYPE	LENGTH	START	END
197	BUREAU	N	2	502	503
198	PAYPLAN	N	2	504	505
199	GRADE	N	2	506	507
200	STEP	N	2	508	509
201	EDUCATION	N	2	510	511
202	YEAR DEGREE ATTAINED	N	2	512	513
203	RACE	N	1	514	514
204	TOTAL FEDERAL SERVICE MONTHS	N	3	515	517
205	TOTAL FEDERAL SERVICE YEARS	N	2	518	519
206	AGE	N	2	520	521
207	YEARLY COMPENSATION	C	6	522	527
208	METROPOLITAN STATISTICAL AREA	N	4	528	531
209	WAGE AREA	N	3	532	534
210	DOD OCCUPATION GROUP	N	4	535	538
211	SEASONAL FLAG	N	1	539	539
212	CENSUS REGION	N	2	540	541
213	CENSUS DISTRICT	N	1	542	542
214	CREDITABLE MILITARY SERVICE (YYMM)	N	4	543	546
215	DATE OF LAST PROMOTION (YYMM)	N	4	547	550
216	DATE ENTERED GRADE (YYMM)	N	4	551	554
217	SALARY	C	6	555	560
218	RATING	N	1	561	561
219	SUPERVISORY	N	1	562	562
220	PATCO	N	1	563	563
221	FUNCTIONAL AREA	N	1	564	564
222	CONSOLIDATED MSA	N	2	565	566
223	INSTRUCTIONAL PROGRAM	C	6	567	572
224	SERVICE COMPUTATION DATE (YYMM)	N	4	573	576
225	CITIZEN	N	1	577	577
226	DATE OF BIRTH (YYMM)	N	4	578	581
227	OCCUPATION	C	5	582	586
228	VETERANS PREFERENCE	N	1	587	587
229	TENURE	N	1	588	588
230	SEX	N	1	589	589
231	AGENCY	N	1	590	590
232	BUREAU	N	2	591	592
233	PAYPLAN	N	2	593	594
234	GRADE	N	2	595	596
235	STEP	N	2	597	598
236	EDUCATION	N	2	599	600
237	YEAR DEGREE ATTAINED	N	2	601	602
238	RACE	N	1	603	603
239	TOTAL FEDERAL SERVICE MONTHS	N	3	604	606
240	TOTAL FEDERAL SERVICE YEARS	N	2	607	608
241	AGE	N	2	609	610
242	METROPOLITAN STATISTICAL AREA	N	4	611	614
243	WAGE AREA	N	3	615	617
244	DOD OCCUPATION GROUP	N	4	618	621
245	SEASONAL FLAG	N	1	622	622
246	CENSUS REGION	N	2	623	624
247	CENSUS DISTRICT	N	1	625	625
248	CREDITABLE MILITARY SERVICE (YYMM)	N	4	626	629
249	DATE OF LAST PROMOTION (YYMM)	N	4	630	633
250	DATE ENTERED CURRENT GRADE (YYMM)	N	4	634	637
251	PAYRATE	C	6	638	643
252	BASIC PAY	C	6	644	649
253	RATING	C	1	650	650
254	SUPERVISORY	N	1	651	651
255	PATCO	C	1	652	652
256	FUNCTIONAL AREA	N	1	653	653
257	CONSOLIDATED MSA	N	2	654	655
258	INSTRUCTIONAL PROGRAM	C	6	656	661
259	NATURE OF ACTION DATE (YYMM)	N	4	662	665
260	COUNTRY	N	2	666	667
261	STATE	C	2	668	669
262	CITY	C	4	670	673
263	COUNTY	C	3	674	676
264	RATING PATTERN	C	1	677	677
265	RATING PERIOD (YYYYMM)	C	6	678	683
266	SERVICE COMPUTATION DATE (YYMM)	N	4	684	687
267	CITIZEN	N	1	688	688
268	DATE OF BIRTH (YYMM)	N	4	689	692
269	OCCUPATION	C	5	693	697
270	VETERANS PREFERENCE	N	1	698	698
271	TENURE	N	1	699	699
272	SEX	N	1	700	700
273	AGENCY	N	1	701	701
274	BUREAU	N	2	702	703
275	PAYPLAN	N	2	704	705
276	GRADE	N	2	706	707
277	STEP	N	2	708	709
278	EDUCATION	N	2	710	711
279	YEAR DEGREE ATTAINED	N	2	712	713
280	RACE	N	1	714	714
281	TOTAL FEDERAL SERVICE MONTHS	N	3	715	717
282	TOTAL FEDERAL SERVICE YEARS	N	2	718	719
283	AGE	N	2	720	721
284	METROPOLITAN STATISTICAL AREA (MSA)	N	4	722	725
285	WAGE AREA	N	3	726	728
286	DOD OCCUPATION GROUP	N	4	729	732
287	SEASONAL FLAG	N	1	733	733
288	CENSUS REGION	N	2	734	735
289	CENSUS DISTRICT	N	1	736	736
290	CREDITABLE MILITARY SERVICE (YYMM)	N	4	737	740

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX C. TABLES FOR "NEW HIRES" MODELS

Table C.1. Variable Definitions and Descriptive Statistics for Salary Model (New Hires, N = 7,495)

Variable Name	Variable Description		
Dependent Variable			
ln (SALARY)	Log of annual salary for the year 1986		
Independent Variables		**N**	**%**
FEMALE	1 = Female 0 = Male	2,832 4,663	37.8 62.2
BLACK	1 = Black 0 = Not Black	764	10.2
HISPANIC	1 = Hispanic 0 = Not Hispanic	269	3.6
WHITE*	1 = White 0 = Not White	5,744	76.6
OTHERACE	1 = Other Race 0 = Not Other Race	718	9.6
VETERAN	1 = Veteran 0 = Not Veteran	518 6977	6.9 93.1
BA_BS86*	1 = Individual has a Bachelor's degree in 1986 0 = Individual doesn't have a Bachelor's degree in 1986	6,331	84.5
MA_MS86	1 = Individual has a Master's degree in 1986 0 = Individual doesn't have a Master's degree in 1986	970	12.9
PHD86	1 = Individual has a Ph.D. degree in 1986 0 = Individual doesn't have a Ph.D. degree in 1986	194	2.6
METROP86	1 = Metropolitan Area 0 = Not Metropolitan Area	6,183 1,312	82.5 17.5
NEWENG	1 = Census Region is New England 0 = Census Region is not New England	289	3.9
MIDATLAN	1 = Census Region is Mid Atlantic 0 = Census Region is not Mid Atlantic	718	9.6
EASTNC	1 = Census Region is East North Central 0 = Census Region is not East North Central	706	9.4
WESTNC	1 = Census Region is West North Central 0 = Census Region is not West North Central	313	4.2
SOUTHAT	1 = Census Region is South Atlantic 0 = Census Region is not South Atlantic	2,351	31.4
EASTSC	1 = Census Region is East South Central 0 = Census Region is not East South Central	330	4.4
WESTSC	1 = Census Region is West South Central 0 = Census Region is not West South Central	962	12.8
MOUNTAIN	1 = Census Region is Mountain 0 = Census Region is not Mountain	360	4.8
PACIFIC*	1 = Census Region is Pacific 0 = Census Region is not Pacific	1,466	19.6

Table C.1. (cont.)

SVISOR	1 = Individual has supervisory position 0 = Individual doesn't have supervisory position	211 7,284	2.8 97.2
PROF	1 = Occupational category is Professional 0 = Occupational category is not Professional	4,251	56.7
ADMIN	1 = Occupational category is Administrative 0 = Occupational category is not Administrative	1,647	22.0
TECH*	1 = Occupational category is Technical 0 = Occupational category is not Technical	578	7.7
CLERK	1 = Occupational category is Clerical 0 = Occupational category is not Clerical	959	12.8
ORHERWC	1 = Occupational category is Other White Collar 0 = Occupational category is not Other White Collar	60	0.8
		N	**Mean**
PRIEXP	Prior Experience in years	7,495	8.06
SQPRIEXP	Square of Prior Experience	7,495	135.04
SALARY	Annual Salary for 1986	7,495	20,680.83
ln(SALARY)	Log of annual salary	7,495	9.88

* Base Case Variable

Table C.2. Variable Definitions and Descriptive Statistics for Promotion Model
(New hires, N=3,695)

Variable Name	Variable Description	N	%
Dependent Variable			
PROMOT	1 = Promoted by 1992	3,267	88.4
	0 = Not promoted by 1992	428	11.6
Independent Variables			
FEMALE	1 = Female	1,256	34.0
	0 = Male*	2,439	66.0
BLACK	1 = Black	389	10.5
	0 = Not Black		
HISPANIC	1 = Hispanic	121	3.3
	0 = Not Hispanic		
WHITE*	1 = White	2,769	74.9
	0 = Not White		
OTHERACE	1 = Other Race	416	11.3
	0 = Not Other Race		
VETERAN	1 = Veteran	3,378	91.4
	0 = Not Veteran*	317	8.6
BA_BS86*	1 = Individual has a Bachelor's degree in 1986	3,102	84.0
	0 = Individual doesn't have a Bachelor's degree in 1986		
MA_MS86	1 = Individual has a Master's degree in 1986	478	12.9
	0 = Individual doesn't have a Master's degree in 1986		
PHD86	1 = Individual has a PhD degree in 1986	115	3.1
	0 = Individual doesn't have a PhD degree in 1986		
RATLEV	1 =Rating level is 1	2	0.1
	2 =Rating level is 2	5	0.1
	3 =Rating level is 3	2,383	64.5
	4 =Rating level is 4	975	26.4
	5 =Rating level is 5	330	8.9
SVISOR	1 = Individual has supervisory position	112	3.0
	0 = Individual doesn't have supervisory position*	3,583	97.0
PROF	1 = Occupational category is Professional	2,190	59.3
	0 = Occupational category is not Professional		
ADMIN	1 = Occupational category is Administrative	877	23.7
	0 = Occupational category is not Administrative		

Table C.2. (cont.)

TECH*	1 = Occupational category is Technical 0 = Occupational category is not Technical	239	6.5
CLERK	1 = Occupational category is Clerical 0 = Occupational category is not Clerical	373	10.1
OTHERWC	1 = Occupational category is Other White Collar 0 = Occupational category is not Other White Collar	16	0.4
FLEET	1 = Functional area is Fleet 0 = Functional area is not Fleet	291	7.9
INTEL	1 = Functional area is Intelligence 0 = Functional area is not Intelligence	260	7.0
MATERIAL	1 = Functional area is Material 0 = Functional area is not Material	1,807	48.9
TRAINING	1 = Functional area is Training and Education 0 = Functional area is not Training and Education	148	4.0
MEDICAL	1 = Functional area is Medical 0 = Functional area is not Medical	120	3.2
HEADQRT	1 = Functional area is Department Headquarters 0 = Functional area is not Department Headquarters	71	1.9
ADMINACT*	1 = Functional area is Administrative Activities 0 = Functional area is not Administrative Activities	998	27.0
		N	**Mean**
AGE86	Employee's age in 1986	3,695	30.8

* Base case variable

Table C.3. Variable Definitions and Descriptive Statistics for Retention Model (New Hires, N = 6,007)

Variable Name	Variable Description		
Dependent Variable		**N**	**%**
RETENT92	1 = Individual is still in DoD in 1992	4,236	70.5
	0 = Individual is not in DoD in 1992	1,771	29.5
Independent Variables			
FEMALE	1 = Female	2,195	36.5
	0 = Male	3,812	63.5
BLACK	1 = Black 0 = Not Black	624	10.4
HISPANIC	1 = Hispanic 0 = Not Hispanic	223	3.7
WHITE*	1 = White 0 = Not White	4,550	75.7
OTHERACE	1 = Other Race 0 = Not Other Race	610	10.2
VETERAN	1 = Veteran	440	7.3
	0 = Not Veteran	5,567	92.7
BA_BS86*	1 = Individual has a Bachelor's degree in 1986 0 = Individual doesn't have a Bachelor's degree in 1986	5,057	84.2
MA_MS86	1 = Individual has a Master's degree in 1986 0 = Individual doesn't have a Master's degree in 1986	778	13.0
PHD86	1 = Individual has a Ph.D. degree in 1986 0 = Individual doesn't have a Ph.D. degree in 1986	172	2.9
FLEET	1 = Functional area is Fleet 0 = Functional area is not Fleet	425	7.1
INTEL	1 = Functional area is Intelligence 0 = Functional area is not Intelligence	357	5.9
MATERIAL	1 = Functional area is Material 0 = Functional area is not Material	2,841	47.3
TRAINING	1 = Functional area is Training and Education 0 = Functional area is not Training and Education	277	4.6
MEDICAL	1 = Functional area is Medical 0 = Functional area is not Medical	363	6.0
HEADQRT	1 = Functional area is Department Headquarters 0 = Functional area is not Department Headquarters	185	3.1
ADMINACT*	1 = Functional area is Administrative Activities 0 = Functional area is not Administrative Activities	1,559	26.0
		N	**Mean**
AVERAGE	Average performance ratings between 1986 and 1992	6,007	3.71
AGE86	Age in 1986	6,007	30.56

* Base Case Variable

Table C.4. Variable Definitions and Descriptive Statistics for Performance Ratings Model (New hires, N=6,404)

Variable Name	Variable Description	N	%
Dependent Variable			
TOP	1 = Individual's average performance rating is greater than sample mean for all employees*	3,082	41.9
	0 = Individual's average performance rating is smaller than sample mean for all employees*	3,322	58.1
Independent Variables			
FEMALE	1 = Female	2,587	40.4
	0 = Male**	3,817	59.6
BLACK	1 = Black	690	10.8
	0 = Not Black		
HISPANIC	1 = Hispanic	249	3.9
	0 = Not Hispanic		
WHITE**	1 = White	4,832	75.5
	0 = Not White		
OTHERACE	1 = Other Race	633	9.9
	0 = Not Other Race		
VETERAN	1 = Veteran	5,926	92.5
	0 = Not Veteran**	478	7.5
BA_BS86**	1 = Individual has a Bachelor's degree in 1986	5,367	83.8
	0 = Individual doesn't have a Bachelor's degree in 1986		
MA_MS86	1 = Individual has a Master's degree in 1986	857	13.4
	0 = Individual doesn't have a Master's degree in 1986		
PHD86	1 = Individual has a PhD degree in 1986	180	2.8
	0 = Individual doesn't have a PhD degree in 1986		
SVISOR	1 = Individual has supervisory position	214	3.3
	0 = Individual doesn't have supervisory position*		
PROF	1 = Occupational category is Professional	3,605	56.3
	0 = Occupational category is not Professional		
ADMIN	1 = Occupational category is Administrative	1,386	21.6
	0 = Occupational category is not Administrative		
TECH**	1 = Occupational category is Technical	567	8.9
	0 = Occupational category is not Technical		
CLERK	1 = Occupational category is Clerical	805	12.6
	0 = Occupational category is not Clerical		
OTHERWC	1 = Occupational category is Other White Collar	41	0.6
	0 = Occupational category is not Other White Collar		

Table C.4. (cont.)

FLEET	1 = Functional area is Fleet 0 = Functional area is not Fleet	789	12.3
INTEL	1 = Functional area is Intelligence 0 = Functional area is not Intelligence	364	5.7
MATERIAL	1 = Functional area is Material 0 = Functional area is not Material	2,789	43.6
TRAINING	1 = Functional area is Training and Education 0 = Functional area is not Training and Education	292	4.6
MEDICAL	1 = Functional area is Medical 0 = Functional area is not Medical	367	5.7
HEADQRT	1 = Functional area is Department Headquarters 0 = Functional area is not Department Headquarters	191	3.0
ADMINACT**	1 = Functional area is Administrative Activities 0 = Functional area is not Administrative Activities	1,612	25.1
		N	**Mean**
AGE86	Employee's age in 1986	6,404	30.7
AVERAGE	Average performance rating	6,404	3.7

*Mean value of average performance rating for all employees (3.7).
**Base case variable.

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF REFERENCES

1. "http://web1.whs.osd.mil/mmid/civilian/tabl.htm " , 5/13/1999, 13:13.

2. "http://dticaw.dtic.mil/prhome/partners.html " , 5/13/1999, 13:53.

3. Statistical Abstract of the United States, 1998, U.S. Department of Commerce.

4. "http://www.dmdc.osd.mil/ids/owa/ids_Civilian.StdRpt?RptNum=10", 5/27/1999, 12:07

5. DoD Directive 1400.25, "Civilian Personnel Management System," November 25, 1996.

6. Federal Employees Almanac, Federal Employees News Digest, Inc., 4th edition, 1999.

7. 1999 Federal Personnel Guide, Key Communications Group, Inc.

8. Title 5, Code of Federal Regulations, Part 335, "Promotion and Internal Placement".

9. Ehrenberg, Ronald G., and Smith, Robert S., *Modern Labor Economics,* 6th edition, Addison-Wesley, copyright 1997.

10. Becker, G. S., *Human Capital,* 2nd edition, National Bureau of Economic Research, 1975.

11. Wise, David A., "Academic Achievement and Job Performance," The American Economic Review, June 1975.

12. Wise, David A., "Personal Attributes, Job Performance, and Probability of Promotion," Econometrica, Vol. 43, No. 5-6 (September-November), 1975.

13. Medoff and Abraham, "Experience, Performance and Earnings," Quarterly Journal of Economics, December 1980.

14. Medoff and Abraham," Are Those Paid More Really More Productive? The Case of Experience," The Journal of Human Resources, 16 (Winter), 1981.

15. Dunson, Bruce, "Pay, Experience, and Productivity: The Government-Sector Case," The Journal of Human Resources, 20 (Winter), 1985.

16. Bowman and Mehay, "Graduate Education and Employee Performance: Evidence from Military Personnel," Economics of Education Review, 18 October 1999.

17. McCue, Kristin, "Promotions and Wage Growth," The Journal of Labor Economics, Volume 14, No.2, 1996.

18. Lewis, Gregory B., "Gender and Promotions," The Journal of Human Resources, Volume 21, No.3, 1986.

19. Ippolito, Richard A., "Why Federal Workers Don't Quit," The Journal of Human Resources, 22 (Spring), 1987.

20. Muchinsky, Paul M., Psychology Applied to Work, 5th Edition, Brooks/Cole Publishing Company, 1996, pp. 222-224.

21. Gujarati, Damodar N., Basic Econometrics, 3rd Edition, McGraw-Hill, Inc., 1995, pp. 556-562.

INITIAL DISTRIBUTION LIST

1. Defense Technical Information Center 2
   8725 John J. Kingman Road, Ste 0944
   Fort Belvoir, VA 22060-6218

2. Dudley Knox Library 2
   Naval Postgraduate School
   411 Dyer Road
   Monterey, California 93943-5101

3. Turkish Army Headquarters Library 1
   (Kara Kuvvetleri Komutanligi Kutuphanesi)
   Bakanliklar - ANKARA
   TURKEY

4. Turkish Navy Headquarters Library.. 1
   (Deniz Kuvvetleri Komutanligi Kutuphanesi)
   06100 Bakanliklar - ANKARA
   TURKEY

5. Professor Stephen L. Mehay, Code SM/Mp 2
   Naval Postgraduate School
   Monterey, CA 93943-5101

6. Professor Julie Filizetti, Code SM/Dg.. 1
   Naval Postgraduate School
   Monterey, CA 93943-5101

7. 1LT Abdullah Usan 3
   Yenice Mah. Asagi Harimarasi Sok. No: 16
   09760 Bozdogan/AYDIN
   TURKEY

8. LTJG Mustafa Utoglu. 3
   Deniz Kuvvetleri Komutanligi
   Personel Baskanligi
   6100 Bakanliklar - ANKARA
   TURKEY